# ELECTRICAL REVIEW

**and WESTERN ELECTRICIAN with which is consolidated ELECTROCRAFT**

VOL. LXIV, No. 2. CHICAGO, SATURDAY, JANUARY 10, 1914. ISSUED WEEKLY.

COMPRISING

ELECTRICAL REVIEW WESTERN ELECTRICIAN ELECTROCRAFT

**ELECTRICAL REVIEW PUBLISHING COMPANY**
608 SOUTH DEARBORN STREET
CHICAGO

Charles W. Price, President and Treasurer.
A. A. Gray, General Manager. H. S. Tuthill, Business Manager.
J. B. McCarthy, Asst. Gen. Mgr. C. W. Forbrich, Asst. Bus. Mgr.

E. E. Wood . . . . . 13 Park Row, New York, N. Y.
Manager Eastern States.
J. B. McCarthy . . . . . Detroit, Mich.
Manager Middle States.
C. W. Forbrich . . . . . Chicago, Ill.
Manager Western States.

**ELECTRICAL REVIEW AND WESTERN ELECTRICIAN**

Charles W. Price.....Editor-in-Chief
A. A. Gray.....Managing Editor
Morton Githens Lloyd.....Technical Editor
F. H. Bernhard.....Associate Editor
Howard Ehrlich .....Associate Editor

SUBSCRIPTIONS.

One Year, United States.....$3.00
One Year, Canada..... 4.00
One Year, Foreign Countries..... 6.00
Single Copy, 10 cents. Back numbers, beyond one month, each .25

Entered as second-class matter, November 7, 1908, at the Post Office at Chicago, Ill., under the Act of March 3, 1879.


CONTENTS.


EDITORIALS:
Church Heating as an Off-Peak Load..... 67
Helping the Electric Railway..... 68
Improving Bank-Counter Lighting..... 68
Cost of Electric Supply in Large Cities..... 69
Meter Conference ..... 69
Cross at the Crossings..... 69
DEPARTMENTS:
Commercial Practice ..... 76
Electrical Construction ..... 78
Dollar Wiring Kinks..... 84
Public Service Commissions ..... 85
Questions and Answers..... 86
New Electrical and Mechanical Appliances.....101
Latest Approved Fittings .....105
Record of Electrical Patents.....112
LEADING ARTICLES:
Electricity in Ice-Making ..... 71
Interior Wiring With Special Reference to its Effect on Lighting Service.—By C. Edward Fee..... 78
A Current-Limit Switch for the Acceleration of Direct-Current Motors.—By M. H. Erdmann..... 90
Electricity Supply of Large Cities.—By G. Klingenberg... 93
BOOK REVIEW .....100
MISCELLANEOUS:
Annual Meeting of Electric Club of Chicago..... 70
Unique Test Demonstrates Efficiency of Boston Edison Employees ..... 76
Public Policy Advertising in Louisville..... 77
Electric Heating for Churches..... 77
Revised Installation Rules ..... 80
A Device for Testing Armatures.—By H. W. Parsons.... 80
Case for Displaying Lamps.—By M. J. Kenney..... 80
Wrong Connection to Meter.—By H. L. Reagan..... 81
Lighting Lathe Work.—By H. G. Wilson..... 81
Transformer Cutouts Short-Circuited by Smoke and Dirt. —By W. E. Rhodes..... 81
Don'ts for Electricians.—By H. M. Nichols..... 82
Wiring System for Alarm Circuits..... 83
Among the Contractors..... 83
Suggestion Plan of Telephone Company..... 88
Reversing Motor Drives and Automatic Control..... 89
Lighting of Store of New Castle Dry Goods Company.— By Louis B. Round..... 92
Independent Telephone Association of America Meets in Chicago ..... 98
Choosing the Lamp Auxiliary.—By H. C. Meredith..... 99
The Problem of Electric Ore-Smelting in Norway.....100



Copyright, 1914, by Electrical Review Publishing Company.


## CHURCH HEATING AS AN OFF-PEAK LOAD.

The principal developments in the use of electrical energy for heating buildings in this country have occurred in those sections of the West where power is supplied from hydroelectric plants and where the demand for mechanical power has been low during the cold season of the year. This applies especially to those projects which have a large connected load in the form of pumping plants used for irrigation purposes. In such cases heating of buildings is decidedly an off-peak load and since the operating costs in hydroelectric plants are small, the managers of these are in a position to offer attractive rates to heating customers.

Any form of a load that comes off the peak can be favored with a low rate by any power company, although of course the conditions are not so favorable and the rate offered cannot be so low with steam plants as with hydroelectric plants. Nevertheless any operating company should be in a position to offer rates for energy to be used for heating buildings whenever this can be limited to such hours of use that there will be no demand for power at the time of peak load.

One class of buildings which in almost any territory will come in this category is the church. The principal use of churches is, of course, made on Sunday, a day when power requirements are at a minimum. Even though afternoon and evening services should require heating of the building after nightfall, the extra load at the time of the usual lighting peak is offset by the fact that in the business sections of the city the lighting load is much less than upon other days. Office buildings, stores, and other commercial buildings use very little light upon Sunday.

It is true, of course, that many churches are in use upon other days of the week. Where evening meetings are held the demand for heating would probably not begin until after the day power load had been cut off, so that these two loads would not be likely to coincide. In other cases where the church would have to be heated during the daytime on week days there would be greater conflict in demand. Most of this heating load, however, would come during the early part of the day when the lighting load is small, and no doubt in all cases arrangements could be made to keep the heating load from coinciding with the afternoon lighting peak. Contracts for

service could definitely specify that energy was not to be used during the peak hours, if this were considered necessary in order to provide a low rate, but in the case of many churches, especially those having few activities during the week, it would be safe for the power company to offer special inducements without limitations as to the hours of use.

It should be remembered in this connection that many churches are only heated at present, by means of furnaces, on days when services are to be conducted, and frequently a new fire must be started in every such case. This means extra work and a greater fuel expenditure than would normally be required for supplying heating during the same period on a continuous-heating basis. This fact should make the proposition for electric heating especially attractive to this class of customers.

Electric heating for church buildings has been tried for some time in certain parts of Continental Europe, such as Switzerland and Germany. News now comes that an installation of this character has been made in Christiania, Norway, where the rate for this service is 0.8 cent per kilowatt-hour. It is doubtful whether a rate as low as this could be made by many American power companies, but it is probably not necessary to make such a low rate in this country to secure the business.

## HELPING THE ELECTRIC RAILWAY.

Several decisions by the Massachusetts Public Service Commission at the close of its 1913 docket point to an appreciation of the burdens of the electric railway which is most gratifying. Without going into the cases individually it is noteworthy that in practically every instance the Commission resisted a proposed reduction in revenue on lines where the rates are less than 1.5 cents per passenger-mile, figuring on the maximum distance available upon a single-fare unit. It is true that in most instances the popular demand was for the extension of transfer privileges—a program which the public often supports without the least idea of its net effect upon the company's income; but the Commission appeared thoroughly alive to the increased cost of living as it bears upon the great industry of electric traction and dismissed the petitions. Most of these affected the Bay State Street Railway, which operates a mixed urban and rural service upon nearly 1,000 miles of track in Eastern New England.

Massachusetts distinguished itself as a pioneer in permitting the advance to a six-cent fare on many lines in place of the shrinking nickel, and it augurs well for the future that its oldest public-utility regulating body continues to appreciate the limitations of the usual five-cent charge. There is little question that, the country over, many electric railways are receiving too small a return for the service which they render; shareholders in such enterprises are timid about further investments of the same character; and the situation needs the sort of treatment referred to above to insure the development of electric traction for which the demands of increasing population and business are calling.

## IMPROVING BANK-COUNTER LIGHTING.

In view of the desirability of bank-counter lighting as a central-station day load, the study of this class of service is important. A noteworthy improvement in bank illumination is apparent in many cities as the result of the tungsten lamp's development, and in new buildings devoted to this business may be found some of the best work of the lighting expert. Counter lighting is becoming more and more important as the convenience of the depositor is studied, and two representative installations of recent design deserve examination.

In the first instance, the bank uses four 25-watt tubular lamps in a horizontal glass-backed reflector for every three feet of reflector length, the lamps being installed on horizontal axes 20 inches above the counter, which has a width of 18 inches. Each lamp is 10 inches long and the resulting illumination is all that could be desired, the energy expenditure being three watts per inch of counter length. The second bank employs 15-watt lamps with the ordinary pear-shaped bulbs, the lamps being installed in a metal reflector with dull white inside finish and spaced 27 inches apart, the energy consumption being about 0.5 watt per inch of counter length. The counter width is 18 inches and the lamp axes, which are horizontal, are located 12 inches above the counter.

A comparison of these installations indicates that either the first is extravagantly equipped or that the second is inadequately illuminated. The latter is the case, notwithstanding the great difference in its favor on the score of lamp height above the working plane. In the second bank only one-sixth the amount of energy per foot of counter used in the first installation is employed, but the use of pear-shaped bulbs on the wide spacing in vogue establishes noticeable dark areas between each pair of lamps, while the quality of general illumination is poor at the counter level. A polished reflecting surface, enamelled or glassed over with mirrors would help materially, and if the lighting units should be exchanged for tubular lamps of the same rating the distribution would be much improved.

By substituting fifteen 10-watt lamps for the eight 15-watt units now employed in a counter length of 20 feet, the watt expenditure per inch could rise to 0.625 and the results would probably show a marked improvement over the existing installation. It is apparent from a comparison of the two counters that a lower expenditure of energy than three watts per inch of counter length can safely be used where it is considered desirable to economize, and that for such spacings as the above mentioned, with intermediate values as well, an expenditure of from 1 to 2 watts per inch with tubular lamps or frequently installed pear-shaped bulbs in high-class reflectors, will insure results alike beneficial to the customer and to the banking institution.

## COST OF ELECTRIC SUPPLY IN LARGE CITIES.

At the December meeting of the Institution of Electrical Engineers in London, England, a paper was presented by Dr. G. Klingenberg entitled "The Electricity Supply of Large Cities." This paper made a comparison between the cost of supply in Berlin, London and Chicago, and will be found in part upon other pages of this issue. Dr. Klingenberg is a director of the Allgemeine Elektricitäts Gesellschaft, of Berlin, Germany, and the results of his study will be of interest to American readers, although the points which were brought out have especial significance for London.

London differs from most other large cities in having its electric supply determined by its political division into a large number of small boroughs, so that there are in all 64 different power plants providing independent supply in their respective territories. As a result the average size of plant and of generator is much smaller than in the other cities; the standby capacity is larger; the investment per kilowatt is larger; and both fixed charges and operating costs are larger. Although many of the London plants are municipally owned and operated, and the average net profit is small, the consumer nevertheless pays for the lack of efficiency in production in a higher average rate for electrical energy. The problem before London is to consolidate her supply so as to avail herself of the efficiencies possible in large generating stations, and her engineers are fully prepared to do this and have realized its desirability for some time, but the political situation makes it impossible at the present time.

In Berlin, as in Chicago, the supply is largely in the hands of a single operating company. These two large cities are about equal in population and have had an almost identical growth since the German capital about a half century ago struck its modern gait. The investment per kilowatt in Berlin has been less than in Chicago, labor costs are smaller, and the electrical energy produced per pound of coal has been larger, but these advantages are largely counterbalanced by the lower price of coal in the American city.

There is a marked difference in the character of the load in the different cities. The Chicago company had a load-factor in 1911 of 41 per cent; Berlin, 33 per cent; and London, 25 per cent. The lighting load still predominates in London, while Chicago is unique in the extent of its railway load. A proper comparison between the three cities cannot be made without taking such conditions into account, and this Dr. Klingenberg has done by using a "utility-factor," which is the ratio of the average load to the capacity of the power plant. This factor is, of course, proportional to the load-factor, but differs from it by the introduction of the element of reserve capacity. It is a convenient term to express the ratio which defines it. Chicago is shown to have had a utility-factor of 33 per cent, while that for Berlin was 18 per cent, and that of London only 12 per cent. By taking this factor into account a better comparison between the cities can be made and the curves connecting the utility-factor with cost per kilowatt-hour are found to be fairly close for the three cities. The large difference in costs is consequently due to this element, but there is still an additional difference due to such elements as the size of plants. The latter feature could be improved in the case of London by a consolidation of her generating stations, which would reduce operating costs 40 per cent, but the larger difference could only be kept down by the acquisition of those elements of load which would tend to equalize the demand upon her stations and increase the utility-factor.

## METER CONFERENCE.

The custom initiated last year by the Ohio Electric Light Association of holding conferences of metermen in various parts of the state proved a valuable innovation, and will no doubt become a permanent feature of that organization. This practice not only permits of more meetings of the men interested in the work of the Meter Committee, but as the various conferences are held in different parts of the state, it permits participation in the discussions by a larger number of men than would ever be brought together at the annual convention of the state association, or at that of the National Electric Light Association. This is especially true in Ohio, since the state conventions are always held at the same point.

This year's committee, which is again under the chairmanship of Mr. A. H. Bryant, has called a meeting in Cleveland, O., for the afternoon of January 16, open to metermen from all electric companies in the state. It will be held in the new meter building of the Cleveland Electric Illuminating Company, which will be inspected in connection with the meeting.

Other state committees might find it advantageous to adopt this conference idea, and thus add to the advantages which membership in a state association brings to the member companies.

## CROSS AT THE CROSSINGS.

The rapid increase in the use of electric and other power vehicles in all of our large cities makes the problem of regulating street traffic more serious year by year. Since the motor vehicles have ordinarily higher speeds than horse-drawn trucks, the question of traffic regulation assumes greater importance than formerly. In considering the question of safety, danger to the pedestrian must be given consideration, and the regulation of the traffic of foot passengers is being considered. In Chicago the experiment of permitting pedestrians to cross streets only under the directions of traffic policemen, as indicated by whistle signals, has been tried, but not put into general practice. In some other cities pedestrians are prohibited from crossing diagonally at street intersections. Accidents frequently occur because pedestrians step into the street without noting the approach of vehicles, especially the silent power cars. The only safe rule for pedestrians to follow is to cross at the crossings.

## Annual Meeting of Electric Club of Chicago.

The annual meeting of the Electric Club of Chicago, marking the close of the 1913 administration was held at the Hotel Sherman, January 6. Following the dinner, which was served at 6:30 p. m., George Keech, retiring president, briefly reviewed the activities of the club during the past year. Reports were then presented by the retiring treasurer and secretary, C. W. Forbrich and Fred M. Rosseland.

Mr. Forbrich's report showed the club to be in a healthy financial condition and despite unusual expenses during the past year a profit of $587.17 was made. The total receipts during the year amounted to $3,383.33 and the expenditures, $3,797.83. The latter includes the cost of an additional $1,000 bond which, with the three other bonds of like amount, makes the total assets of the club $4,234.97.

As chairman of the Membership Committee for 1913, F. W. Harvey reported a gain of 171 during the year, making a total membership, on December 31, of 512 members.

A. R. Bone, incoming president, was then introduced and spoke briefly of the future before the club. The slogan for 1914 will be "1,000 members." William C. Berry and H. Ehrlich were also called upon.

Elaborate entertainment features were provided. The Commonwealth Edison Company orchestra under the leadership of M. L. Eastman and the Edison Glee Club, led by Harold Wright, rendered selections during the evening. A vaudeville program of four numbers concluded the festivities.

## Chicago Section, Electric Vehicle Association of America Meets.

John F. Gilchrist, vice-president of the electric Vehicle Association of America, was the speaker at the regular weekly meeting of the Chicago Section on January 6. He spoke briefly of the work before the Association and of its chief function—the bringing together of central-station interests and vehicle manufacturers.

Regarding conditions in Chicago Mr. Gilchrist said that the development had been exceptionally pleasing. The Commonwealth Edison Company on December 1 reduced its garage rate from 5 cents per kilowatt-hour to 4 and on March 1 the rates for residences will be reduced so that vehicle charging will earn a 3-cent rate, providing the energy used otherwise equals the amount necessary to come under the lower rate. The local company is also considering the plan of renting batteries, fully charged, as inaugurated in Hartford, Conn.

In conclusion Mr. Gilchrist called attention to the street improvement which is continually going on in Chicago and to the absence of grades. These conditions, together with low rates for electricity should have a marked influence on electric-vehicle development.

The meeting on January 13 will be held jointly with the Chicago Garage Owners' Association, at the Lexington Hotel.

## Eye Strain in Telephone Work.

There are in the United States about 125,000 telephone girls, whose average term of service is three years or less. The working hours are about eight per diem; the average number of calls is about 140 per hour, running, at the peak, to 225 or more. When the person calling raises his receiver, a light flashes on the switchboard, and this light continues to burn until the operator plugs the number and receives the call. She then plugs the number called for and this light burns until the called person raises his receiver from the hook. When the receivers are finally replaced on their hooks, both lights flash and burn until the operator removes the connecting plugs. To complete one call means four flashes of light. As the average number of calls is 140 per hour, with 225 or more during the rush hours, the operator's eyes are exposed to from 500 to 1,000 flashes of light every hour, resulting in fatigue to the eyes, to say nothing of the mental and physical strain under which the operator works. The Bell System, in 1911, spent $720,953 for rest-rooms and lunch-rooms for the operators, and it has secured sufficient air space and good illumination, yet, although only young and healthy girls are selected, the average length of service does not exceed three years, reports the American Medical Association. The symptoms of eye-strain which the girls develop are headache, dullness, indigestion, exhaustion, nerve strain, insomnia, colds, and so forth. The two or three short years of telephone work possible to the girls, as well as nine-tenths of all their suffering, is probably due to the constant near-range eyework, without proper protection for the eyes.

## Indirect Lighting Before Chicago Jovian Club.

On Monday, January 5, at the regular noon-day meeting of the Jovian League of Chicago, T. H. Aldrich, engineer for the National X-Ray Reflector Company, delivered an address, illustrated with many pictures, on "Modern Illumination of Interiors."

A feature of the meeting was the presentation of framed resolutions to Past Statesman George C. Richards, by Past Jupiter Sam A. Hobson, for services rendered as statesman and in organizing the Chicago Jovian Club.

F. W. Harvey, appointed alternate statesman, vice E. H. Waddington, who has moved to Cleveland, O., presided.

## Flicker Photometry.

At the meeting of the Philadelphia Section of the Illuminating Engineering Society to be held Friday, January 16, 1914, two papers will be presented: "Deficiencies of the Method of Flicker for the Photometry of Lights of Different Colors," by C. E. Ferree; and "A Reflecting Marker for All Books," by J. N. Rhoades.

As usual the meeting will be preceded with a dinner at 6:30 p. m. at the Engineers' Club, at which place the meeting of the Section also will be held.

## Central-Station Fires.

The plant of the Mauch Chunk Electric Light and Power Company was destroyed by fire December 27. The fire was caused by sparks falling on the roof of the boiler house. The estimated loss is $80,000, covered by insurance to half that amount.

On December 1 the plant at Rockwell City, Iowa, was burned while being remodeled.

The electric light plant at Quenemo, near Ottawa, Kans., was partly destroyed by fire recently, the loss being estimated at $4,000. Insurance amounted to $2,400. Incendiarism is suspected.

## New York Trade School Courses.

The Board of Education, New York City, has announced that the second term at the Murray Hill Trade School began on January 5. Evening sessions are held on Monday, Tuesday, Wednesday and Thursday evenings. Free courses are offered during this term in a large number of subjects, including electrical wiring and installation, and motion-picture operation. Enlarged facilities and additional equipment make it possible to accommodate a larger number of students and the courses are thoroughly practical.

## "White Way" Lighting Contract Secured at Minot.

The city of Minot, N. D., in addition to renewing the present street-lighting contract with the Consumers Power Company covering 12 arcs and 212 series incandescent street lights, has contracted with the company for current for the operation of a new system of "white-way" lighting consisting of 60 ornamental standards, each carrying one 60-watt and four 40-watt Mazda lamps.

# Electricity in Ice-Making.

**It is estimated that there are about 2,000 steam-operated ice plants in this country, which, if operated by central-station power, would mean a consumption of from 600,000,000 to 700,000,000 kilowatt-hours per year. This in itself is a large field for the central station but there is a steady increase in the number of plants, all of which, without question, should be operated with purchased power. General information and specific operating data are given in this article.**

Until a time not exceeding three years ago practically all ice plants of the larger size were operated by steam engines. The reasons for this condition are explained by C. H. Stevens, of the Brooklyn Edison Company, as follows: (1) These plants were making ice from distilled water and were obtaining the greater part of this distillate from exhaust from their engines; and (2) with this handicap of the engine exhaust to overcome, the central station did not consider the field sufficiently important to adopt new rates, where necessary, to apply directly to this business.

While this condition actually did exist three years ago, there are at the present time at least 15 artificial ice plants of over 90 tons capacity which are operating exclusively on central-station service in this country and giving the highest satisfaction, both from the standpoint of efficiency and economy.

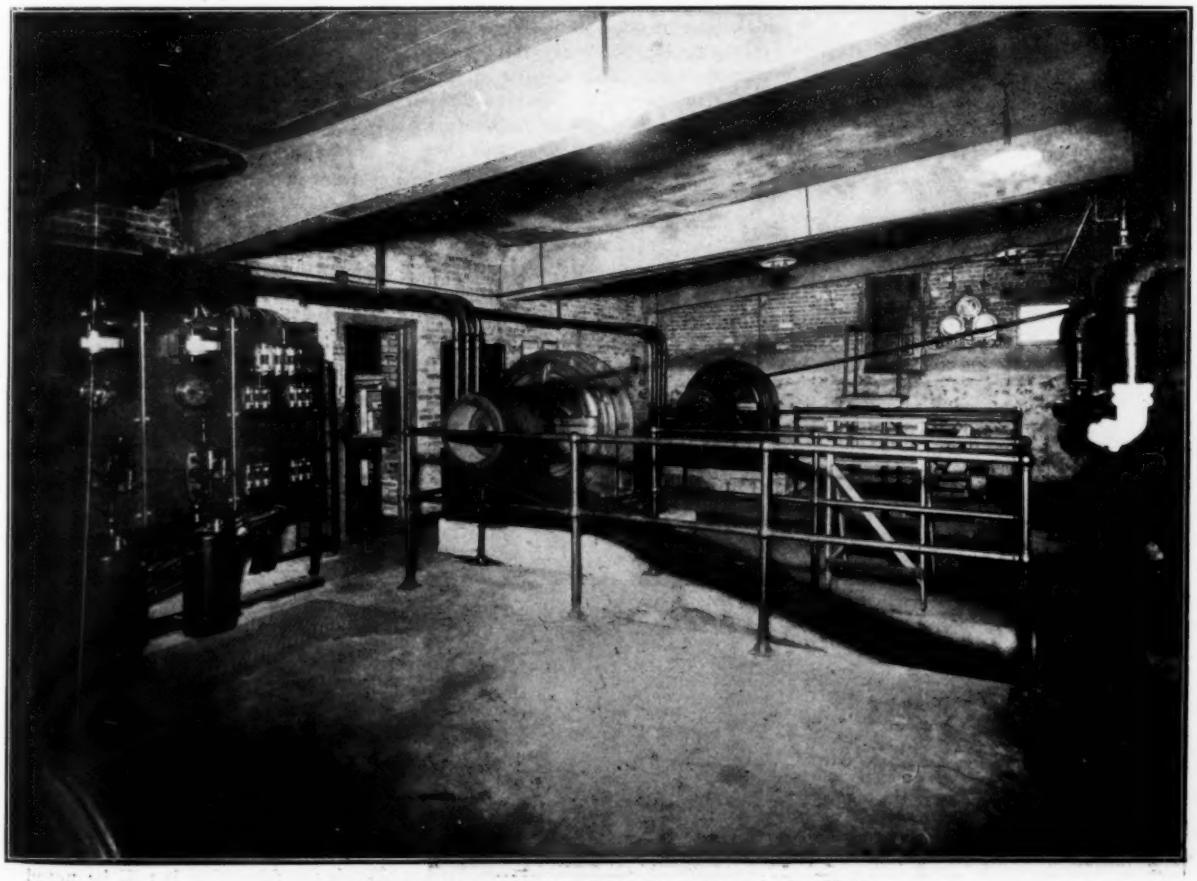
To occasion this marked change in the situation, it is obvious that the former conditions which were against the central stations must have been met and overcome in a very decisive manner, owing to the large proportion of this business which has been secured since that time.

The determining factors which brought about this change were: the use of multiple-effect evaporators in connection with the distilled-water plants; the advent of the raw-water system of making ice; and central-station rates applying directly to this business.

The use of high-pressure multiple-effect evaporators in connection with the distilled-water plants was a most important step in bringing about this change. With this efficient piece of apparatus very high evaporations were obtained—in some instances as high as 50 tons of distillate per ton of coal with an 8-effect evaporator. This made it entirely feasible to drive the compressors and pumps electrically and to produce the distilled water economically direct from the evaporators.

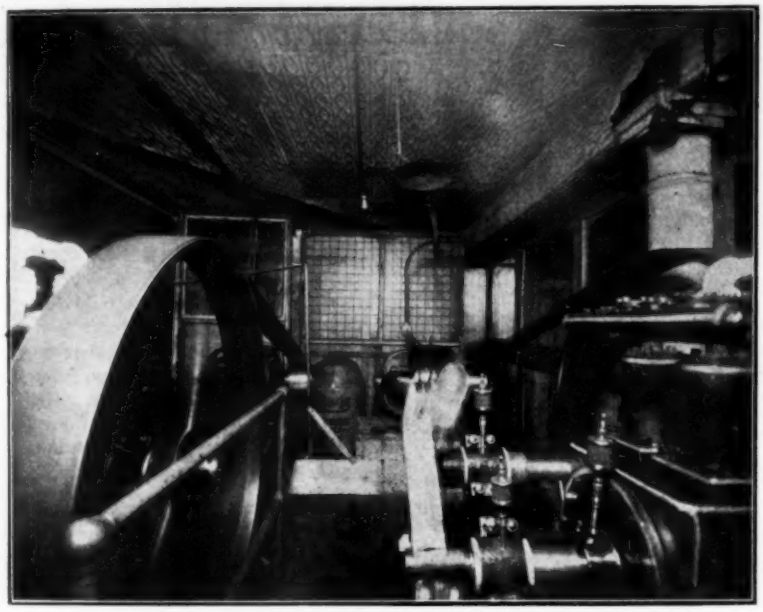
The advent of the raw-water system of making ice was a still further advancement in the science and put the ice plant distinctly within the field of the central station. In this system obtaining distilled water is a secondary and an unimportant item in the cost of production.

With the handicap of steam for distilling purposes removed from both types of plants it was then purely a matter of rates for current that would compare favorably with other sources of power for driving the compressors.



Two 50-Horsepower Motors Driving Compressors in Ice Plant.

At the Chicago convention of the National Electric Light Association the Committee on Refrigeration, of which George H. Jones, of the Commonwealth Edison Company, was chairman, presented an exhaustive report on the subject which treated at some length the subject of ice-making. These data were based, to a large extent, upon the investigations and experiences of Mr. Jones who has made a special study of the subject and who has succeeded in obtaining several large plants in Chicago for the Edison Company. These plants include The Consumers Company (three plants) with a total connected horsepower of 1,435; the Englewood Distilled Water Ice Company, 500 horsepower; Mutual Manufactured Ice Company, 306 horsepower; Crystal Manufactured Ice Company, 285 horsepower; Lincoln Ice Company, 535 horsepower, and other smaller plants. The data Mr. Jones presented in this report are extracted herewith, these being the most authoritative treatment of the subject so far presented.

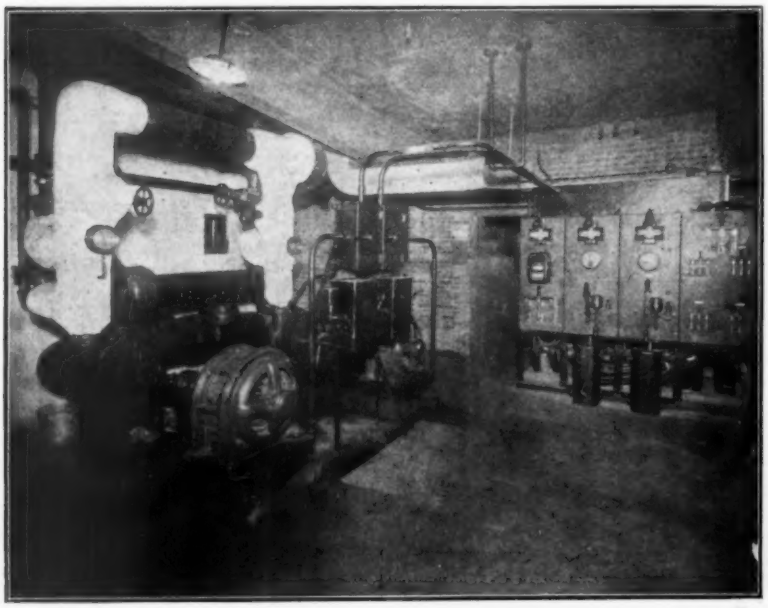


Motor-Driven Compressors.

One of the principal advantages of the electrically operated ice plant is that it may be built at or near the center of the territory to which it is to supply ice, irrespective of railroad facilities. This is a very important point, as it is a well established fact that a very large item of cost in the ice business is that of delivery to the consumer. The ideal arrangement is to install plants of from 80 to 100-ton capacity about two miles apart, so that each plant will supply the territory within a radius of a mile, thus reducing delivery to a minimum. One other point of advantage is that better ice can be produced, as the trouble frequently encountered in steam-driven plants of having oil carry over from the engine cylinder is entirely eliminated.

In view of these conditions the question is how large a proportion of this business can be secured to the mutual advantage of the central station and the manufacturer. The fact that at the present time most of the ice plants are steam-driven should not discourage the central-station men, as it is only recently that this matter has been investigated and gone after by the central station.

Before proceeding further with this discussion it might be well to point out a few physical facts in connection with the manufacture of ice.



Motor-Driven Pumps in Ice Plant.

(1) Chemically pure water free from air will freeze solid and clear.

(2) Water containing impurities in solution tends in freezing to force impurities out of solution. The slower the process of freezing the more completely is the purification effected.

(3) Ice formed in still water sends out long slender crystals, which increase in number and size, forming a meshwork which gradually becomes a solid mass.

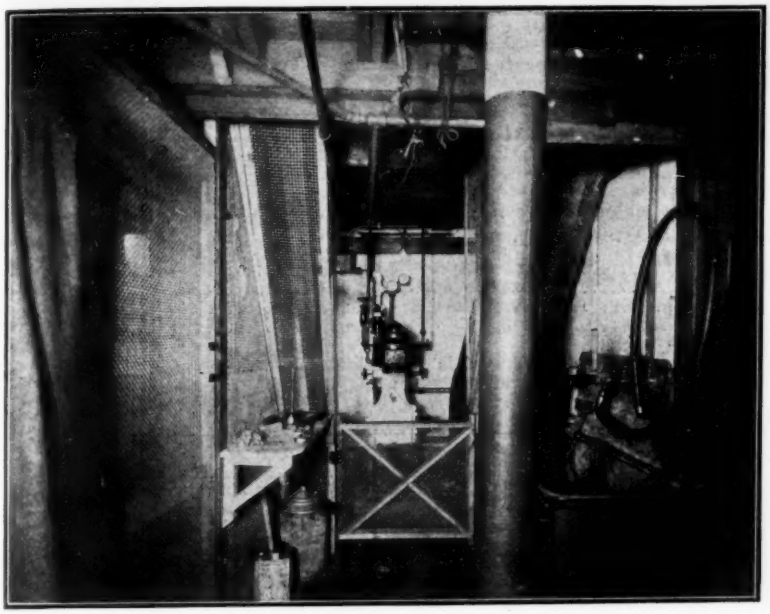
(4) Agitation of water during freezing aids in the separation of impurities and is, therefore, of value in the forming of solid clear ice.

(5) Practically all natural waters contain air and more or less organic or inorganic material in solution. These substances tend to cause the ice formed to be opaque, but as they are frozen out of solution, those that are light rise and collect near the surface, and heavier ones stay near the bottom.

(6) The rate of ice freezing increases as the thickness already formed increases. The time required to freeze increases as the square of the thickness to be frozen. The formation of natural ice is from the top down and impurities frozen out of solution fall. This and the motion of the water, especially in quiet-running streams, tend to make natural ice transparent. American manufacturers of ice have always tried to duplicate this clearness, although in foreign countries opaque ice is frequently used commercially.

**Distilled-Water Ice-Making.**

From the foregoing it will be noted that distilled water will freeze solid



Motor-Driven Centrifugal Pump.

and practically clear. This is doubtless one of the main reasons why such a large number of plants now in existence are making ice from distilled water. The plan was to utilize the condensed water from the engines for a large part of the distillate. It might be thought by a casual observer that this was an ideal arrangement against which purchased power could not compete. The situation has been met, however, in two ways, (1) by making raw water ice, i. e., freezing the water without first distilling it, and (2) in cases where distilled water ice is desired, by securing the necessary distilled water by means of a multiple effect evaporator. This is an efficient piece of apparatus for securing a very high evaporation of water per pound of coal. With this apparatus six times as much water can be evaporated per pound of coal as with the ordinary boiler. To secure this result, advantage is taken of the fact that water will under vacuum evaporate at a much lower temperature than under ordinary conditions.

Evaporators for ice-plant work are classified broadly into two types—exhaust and high pressure. With the former type we are not directly interested, except that it represents the economy of the steam-driven plant which we must offset with the other advantages of central-station power. In a standard non-condensing steam-driven ice plant the losses vary from 10 to 20 per cent, and hence 100 tons of distilled water in the cans means at least 115 tons produced or handled. Of this amount the compressors and auxiliaries will furnish not over 90 tons, hence a make-up of 20 to 25 tons must be bled from the boilers at the average rate of evaporation of the plant. The exhaust-steam evaporator in single effect with an economy of 8 tons of distillate per 10 tons of steam, supplies this make-up with a consequent direct saving in coal represented by this evaporation in the boiler less pump charges. With two effect plants operating from a few pounds above atmosphere to, say, 25 inches of vacuum, the economy may be increased to a ratio of 2.25 to 1 of steam.

If the plant be put upon a standard compound condensing basis a still greater efficiency exists, say 60 per cent of the total coming from the evaporators, and the cost of production is still more against central-station power. Evaporators for the service may be two or more effects, depending upon the price of coal. Their economy may run to as high as 5.5 to 1.

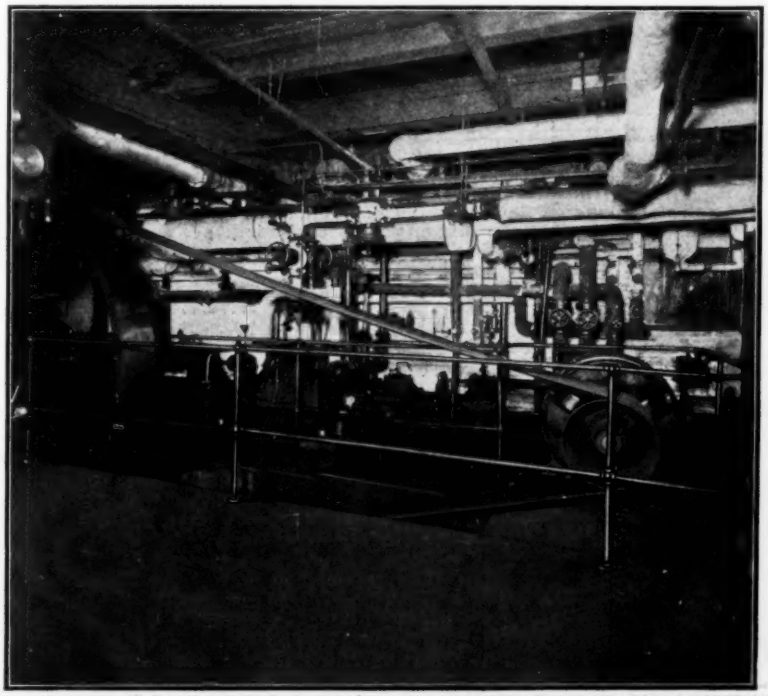
For motor-driven ice plants the problem is merely to produce the distilled water as cheaply as possible, and resolves itself into a consideration of capital investment versus efficiency, and the governing factor is usually the price of fuel. With motor-driven pumps, and eight-effect plant will give an economy of 6 to 1, and hence produce with average western coal and boiler performance, 45 to 48 tons of distilled water per ton of coal. It is seldom economy to exceed eight effects.

When central-station power is being considered by the ice-plant operator the assumption is justifiable that his fuel cost is at least moderately high. With this premise it is easy to point out to him that in securing the benefits of electric drive he is also gaining something from the operating point, some of the benefits being as follows:

(1) He can secure an absolutely oil and air-free distilled water by use of the evaporators.

(2) His cost to produce this water is very low per ton of ice made.

(3) His investment may be so pro-



50-Horsepower Motor Driving Compressor.

## Ice-Making Data.

**The term load-factor is used in these data in such a sense that a load-factor of 100 per cent represents the use for 24 hours every day of power corresponding to the rated capacity of the motors connected. An operating-time load-factor of 100 per cent represents the use of the rated capacity of the motors for the running hours per day specified for each installation.**

Lincoln Ice Company, Chicago, Ill. This company has a capacity of 120 tons of ice per day. The actual output during the year covered by the consumption figures was 27,839 tons. The raw-water, can system is employed. Plant operates 168 hours per week.

Total connected horsepower, 511. Total number of motors installed, 11. Average kilowatt-hours per month, 121,255. Kilowatt-hour consumption for 12 months:

| Month | Kilowatt-hours | Month | Kilowatt-hours | Month | Kilowatt-hours |
|---|---|---|---|---|---|
| March | 76.600 | July | 237,500 | November | 71,308 |
| April | 97,100 | August | 224,000 | December | 32,001 |
| May | 127,300 | September | 192,551 | January | 48,447 |
| June | 167,300 | October | 112,419 | February | 68,486 |

Load-factor, 43 per cent.

The electrical energy consumption per ton of ice manufactured is 52.2 kilowatt-hours.

MOTOR INSTALLATION.

The following is a list of the motors installed with their respective drives. The supply source is three-phase, 60 cycles, 230 volts.

| No. | Horse-power. | Speed R. P. M. | Application. |
|---|---|---|---|
| 1 | 150 | 514 | Slip-ring motor belted direct to one 60-ton Giant compressor. |
| 1 | 300 | 514 | Slip-ring motor belted direct to one 120-ton Giant compressor. |
| 2 | 15 | 900 | Each belted direct to an air compressor. |
| 1 | 2 | 1,120 | Belted direct to an agitator. |
| 1 | 2 | 1,120 | Direct-connected to one distilled-water pump. |
| 2 | 1 | 1,120 | Each direct-connected to a vacuum pump. |
| 2 | 10 | 900 | Each driving one condenser. |
| 1 | 5 | 1,120 | Direct-connected to an ice hoist. |

Crystal Ice Company, Chicago, Ill. This is a raw-water ice plant using the can system. The rated capacity of the plant is 60 tons of ice per day while the actual output during the 10 months covered by the kilowatt-hour consumption figures was 9,656 tons. Plant operates 168 hours per week.

Total connected horsepower, 235. Total number of motors installed, 7. Average kilowatt-hours per month, 62,218. Average kilowatt-hours per month per horsepower connected, 254.

Kilowatt-hour consumption for 10 months.

| Month | Kilowatt-hours | Month | Kilowatt-hours | Month | Kilowatt-hours |
|---|---|---|---|---|---|
| June | 91,200 | October | 45,959 | January | 24,243 |
| July | 123,400 | November | 32,064 | February | 29,450 |
| August | 119,800 | December | 933 | March | 45,450 |
| September | 109,697 | | | | |

Load-factor, 49 per cent.

The electrical energy consumption per ton ice manufactured is 64.5.

MOTOR INSTALLATION.

The following is a list of the motors installed with their respective drives. The supply source is three-phase, 60 cycles, 230 volts.

| No. | Horse-power. | Speed R. P. M. | Application. |
|---|---|---|---|
| 1 | 150 | 500 | Belted direct to one 60-ton Wolf compressor. |
| 1 | 25 | 900 | Belted direct to a 15-ton Wolf refrigerating machine. |
| 1 | 20 | 900 | Belted direct to air compressor. |
| 2 | 5 | 1,120 | Each belted direct to an agitator. |
| 1 | 25 | 900 | Geared direct to a deep-well pump. |
| 1 | 5 | 1,120 | Geared direct to an ice hoist. |

Knickerbocker Ice Company, Chicago, Ill. This plant manufactures ice from distilled water, employing the can system. The rated capacity of the plant is 120 tons of ice per day, while the actual output during the eight months specified was 32,500 tons. Running hours per week, 168.

Total connected horsepower, 564. Total number of motors installed, 20. Average kilowatt-hours per month, 182,239. Average kilowatt-hours per month per horsepower connected, 323.

Kilowatt-hour consumption for 8 months.

| Month | Kilowatt-hours | Month | Kilowatt-hours | Month | Kilowatt-hours |
|---|---|---|---|---|---|
| May | 117,000 | August | 216,700 | November | 152,445 |
| June | 190,000 | September | 205,802 | December | 160,619 |
| July | 211,000 | October | 204,312 | | |

Load-factor, 59 per cent.

The electrical energy consumption per ton of ice manufactured is 44.7 kilowatt-hours.

MOTOR INSTALLATION.

The following is a list of the motors installed with their respective drives. The supply source is three-phase, 60 cycles, 220 volts.

| No. | Horse-power. | Application. |
|---|---|---|
| 2 | 200 | Each belted to a 50-ton York compressor. |
| 8 | 2 | Each belted direct to an agitator. |
| 1 | 75 | Geared to deep-well pump. |
| 1 | 40 | Geared to contrifugal water pump. |
| 2 | 5 | Driving two centrifugal brine pumps. |
| 1 | 10 | Geared to elevator mechanism. |
| 2 | 1 | Each geared to ice hoist. |
| 1 | 3 | Driving coal hoist. |
| 1 | 3 | Driving mechanical stoker. |
| 1 | 3 | Geared to coal conveyor. |

portioned to his fuel cost that the cost to produce the distilled water will be a minimum under all conditions.

(4) His boiler plant is reduced to approximately one-sixth of the capacity required with a steam-driven plant.

(5) The amount of condensing water required for his steam condenser is likewise reduced, it being necessary only to condense the vapor from the last effect, for the reason that each evaporator forms the condenser for the previous effect.

(6) The system of heat exchangers employed permits the boiler feed as well as the evaporator feed to be heated to a high temperature which conduces to high economy.

(7) The modern evaporator construction enables the operator to clean the evaporator with less trouble than the average boiler can be cleaned.

(8) The amount of distilled water produced and hence of coal burned may vary with his requirements, whereas, in a steam plant his production of distilled water remains almost constant.

(9) The only water losses in a motor-driven plant are filling losses which are the smallest water losses in the plant.

In distilling equipment of this kind it is essential that all piping be tinned on the inside so as to prevent the distilled water from attacking iron and thus discoloring the water.

**Raw-Water Plants.**

In order to do away with the necessity of using distilled water many raw-water plants have been built and are giving very good results. One of the items which must have an important bearing on the establishments of such plants will be the character of the water supply. In some sections of the country where the water contains a large amount of mineral substance in solution, it may be difficult to secure clear raw-water ice, but ordinarily there is very little difference in the appearance of distilled-water ice and raw-water ice as manufactured in the best plants.

The methods of manufacture of raw-water ice can be classed under two general heads—the first known as the can system and the second as the plate system. Practically all of the plants now in operation are of the can type, although there are a few of the plate variety.

In a can plant the ice is formed in large cans in which filtered raw water has been placed, these cans being immersed in tanks of refrigerated brine which is being constantly circulated by means of pumps. During the process of freezing the water in the cans is agitated by means of compressed air, which agitation is necessary in order to secure clear ice, as previously explained. The water in the cans is permitted to freeze until the core is reached, at which time the core water is replaced by distilled water and the cake frozen solid, leaving simply a feathery effect through the middle of the cake. This removal of the raw water from the core is necessary in order to secure a clear cake of ice, as, of course, it would be impossible to agitate the raw water until it is entirely frozen. Then, too, the water which has been removed from the core contains practically all of the impurities from the entire can. This process involves the use of between 15 and 20 per cent of distilled water which can be supplied by means of a small multiple-effect evaporator, such as is used in regular distilled-water establishments.

In the plate type of plant hollow plates through which cold brine or ammonia can be made to circulate, are immersed vertically in tanks filled with water which is agitated. The ice forms gradually on both sides of the plates, thus ridding itself of any air or other impurities on its surface. In the can system these impurities concentrate toward the center, forming an impure core which is removed as previously explained. With the plate system it is not necessary to distill or boil water which is otherwise pure for ice making. The plate plant, however, requires more skill to manipulate it successfully, and is more expensive to install and keep in repair.

In this system when the ice is formed to the desired thickness, it is loosened from the freezing plates by various thawing arrangements. The ice cakes, often 9 feet by 16 feet by 12 inches in thickness, are lifted from the tanks by overhead cranes, and are carried to a table where they are cut to commercial size.

In order that the successful operation of an electrically driven ice plant may be assured, it is necessary that a proper equipment be installed. One of the important features is the type of motor to be used. In all probability the great majority of the plants to be considered will be located in territory in which the central-station supply is alternating current; in fact, all of the large plants thus far constructed have been equipped with three-phase motors.

There is some difference of opinion as to whether motors should be designed for constant speed or variable speed. In any event, they should be of the slow-speed, slip-ring induction type, and equipped with drum controllers. In case constant-speed work is desired, the resistance to be furnished with the controller need be large enough simply for starting the motor. If at a later time it becomes desirable to operate the motor at variable speed, the only change required will be to install additional resistance. The use of multi-speed motors has been suggested for this class of work, but this practice should be discouraged, as the efficiency of the motor at full load is not quite as high as the standard motor, and, furthermore, the power-factor is considerably lower.

While some of the companies have adhered to the standard practise of using 220-volt motors, others have adopted the plan of operating the large compressor motors at primary voltage of approximately 2,300 volts, using lower voltage on motors operating the auxiliaries. The efficiencies of three-phase motors are the same at either 230 volts or 2,300 volts. The factors involved in making a choice are the economies in operation due to the elimination of transformer losses, and the comparative costs of first installation. The use of primary voltage on motors, however, introduces a certain risk to attendants which many of the large companies hesitate to assume.

The question is often asked whether or not an electrically operated plant can be made to operate as cheaply as a steam-driven plant when the location is favorable to the steam plant, that is, when ample railroad facilities are available so that coal can be brought in under the best conditions. This question is best answered in the words of one of the largest ice operators in the country, who has a number of distilled-water ice plants, both steam and electric. He states that under his conditions of operation there is practically no difference in the cost of manufacture under the two systems. Under the electric plan of operation, however, he can locate plants to best suit his needs, and, furthermore, the possibility of contamination from oil is removed, which is a point of much value.

Data on several electrically operated ice plants are given in the accompanying data sheets.

## New York Edison 1914 Calendar.

**The New York Edison Company is noted for the fine quality of its printed literature. The company maintains an extensive advertising department presided over by one of the most eminent advertising experts in the country. The company's 1914 calendar is in line with the other products of this department, showing the Edison service man leading Father Time. The illumination is furnished by an incandescent lamp held on a platter.**

# Commercial Practice
# Management, Rates, New Business

## Unique Test Demonstrates Efficiency of Boston Edison Employees.

A unique test to determine the facilities of the company for handling a serious accident at night was recently conducted by the Edison Electric Illuminating Company, of Boston, and the results are interestingly chronicaled in *Edison Life* as follow:

What would happen in the event of a serious accident to any of the company's property in any part of its territory, interrupting service to our customers?

That is a question which may have arisen in the minds of all of us and caused various lines of speculation. There is one thing that surely would happen—and that is that every man directly interested in and intimately connected with the successful operation of the system would be on the spot within a very short period of time, ready to do his part toward restoring the service to its usual high plane. Several slight accidents have previously demonstrated this fact, but our general superintendent desired to make a test on a broader scale, and evolved a plan that proved the greatest surprise that Edison men have had sprung on them for some years.

"I have been planning in my own mind to test the efficiency of the working force in an emergency at a convenient opportunity," Mr. Atkins confided in Mr. Hancock as they were returning from a business engagement on the evening of December 4, "and this is the night." LaRue Vredenburgh and John Buckley who were in the party were "let in" to take charge of details. They all proceeded at once to the heart of the Edison system—L Street Station—and there Mr. Atkins unfolded his plans.

It was just 11:10 p. m. when W. J. Kennedy, chief engineer of the L Street station, was called in by telephone. Being a night owl, he had not yet retired, so he at once pressed his private car into service, and arrived from Dorchester at the station at 11:25, only 15 minutes after the message was received.

Another telephone call at the same time found W. F. Crowell, of the telephone division, in bed. "Come to '39' for a test" was the message, and Crowell hurried to 39 Boylston Street where he arrived at 11:33, and with the assistance of three night operators made plans to send out calls to all those on the emergency list.

On the stroke of 12 o'clock, midnight, the telephone system commenced its part of the program. Telephone bells were soon arousing the families in scores of Edison homes. Within 37 minutes, each one of the 45 names on the list had been called up, and the terrible message, "Serious trouble at L Street" had been transmitted with instructions to report at once for duty.

The test was really not a call to L Street only, it was a call to duty, whether to L Street, to the garage, telephone or stock room. Men called by the operator passed the call to certain of their men for assistance.

The message sent by Superintendent Larrett of the maintenance department, brought all the district foremen to their respective stock rooms. These men are in charge of the lines in large territories, each including several cities and towns. They waited at the stock rooms for "orders." Superintendent W. F. Stevens of the supply department relayed his call to men who reported at the main stock room, service buildings; and were ready to furnish supplies upon receiving the word. In the same manner Superintendent Smith sent messages to chauffeurs that were needed. Twenty-one men were available as drivers including his night men.

Of course all these calls required considerable time, since in many cases it was necessary to make use of toll lines and messenger service.

The busy scenes enacted in many of the homes at this time in the early morning can be imagined. While the men were scrambling into their clothes their wives were telphoning instructions and seeking information. In this connection honorable mention should be accorded to members of the Edison families who gladly assisted their husbands in their hurried get-away, proving in this way that the spirit of Edison loyalty has pervaded the homes of our employees.

Automobiles, taxis, hacks and anything else which could be found on wheels, rushed their startled occupants toward the scene of the imagined calamity. On the way some of the men hailed gangs of workmen, who were engaged in night work on the line, and started them towards the one spot foremost in all minds. From 12:15, the time of the first arrival at L Street, until about 2 a. m. men came rushing in from all quarters, dressed in all fashions ready to work. They descended upon the place like a swarm of bees, until something like 100 faces had been transformed from a frown of dismay to a smile of relief.

Pierce Kent, who lives about 100 yards from the station, arrived at 12:15, just four minutes after he had received his notice; while J. C. Norcross, who lives 16 miles from the L Street station, travelled in a local taxi and reported in one hour and 19 minutes.

Besides the hundred and more that reported at L Street there were two score men who reported at the various stock rooms, and the garage. Unfortunately the time of arrival of everyone could not be checked, some of the men failing to register. An analysis of the data at hand shows that notwithstanding the delays, satisfactory results were obtained as follows:

| Time of arrival | Average distance from L St. | Average time |
|---|---|---|
| 12:11-12:30 | 3 miles | 17 minutes |
| 12:30-1 | 3¾ " | 34 minutes |
| 1-1:30 | 4½ " | 45 minutes |
| 1:30-1:52 | 9 " | 67 minutes |

## Echoes of Louisville Merger.

Charging that excessive rates for gas and electricity have followed the merger of the gas and electric companies of Louisville, Ky., the People's Protective League has been organized in that city for the purpose of taking legal steps to dissolve the merger, which resulted in the organization of the Louisville Gas & Electric Company. The organization of the league has followed putting into effect the agreement between the company and the city, by which the Louisville Gas & Electric Company, in return for constructing a natural-gas line from West Virginia and enabling gas to be sold at 35 cents, was permitted to increase its rates for electric lighting, which had been depressed by the competition between the companies formerly in the field. On this account, many uninformed people have agitated for a return to the old conditions. The company has franchises created by the city for its operation, as well as a definite contract, so that there appears to be little chance for the reduction.

## Growth of the Western States Gas & Electric Company.

Since the Western States Gas & Electric Company (Richmond, California, Division) was taken over for management by H. M. Byllesby & Company, the company's connected load has increased as follows:

| | Nov. 1913 | Dec. 1910 | Increase | Increase % |
|---|---|---|---|---|
| Number of customers | 2,733 | 1,163 | 1,570 | 135 |
| Kilowatts Ltd. load | 2,440 | 979* | 1,517 | 155 |
| Flatirons | 1,320 | 432 | 888 | 205 |
| Signs | 48 | 12 | 36 | 300 |
| Horsepower motors | 4,443 | 1,582 | 2,861 | 180 |
| Total KW. all purposes | 5,812 | 2,279* | 3,533 | 150 |

*March, 1911.

The ratio of meters to population has more than doubled, there being one meter to every four of population now as compared with one meter to every 8.4 of population in 1910.

Richmond is one of the fastest growing communities in the United States today. Ten years ago the present business section was a prairie. Today the city has a population estimated at 16,000 people. It is strictly a manufacturing town. With the approval of the Rivers and Harbor Board at Washington of the proposed harbor, Richmond will have when completed the best harbor and the closest one to Golden Gate of any city on San Francisco bay.

## Public Policy Advertising in Louisville.

In a recent issue we called attention to a new trademark and slogan which the Louisville (Ky.) Gas & Electric Company had adopted and the policies for which it stands. The accompanying advertisement appeared in all Louisville newspapers during Christmas week and is the second of a series that will be published in familiarizing citizens of the city with the spirit of the slogan the company has adopted, "Your Partner."

The text is indicative of the most modern thought in public policy attitudes and is reproduced in full herewith.

"At this time when the subject of Good Will is emphasized in the mind of the world, it seems proper to discuss the good will which should and can prevail between the people and utility corporations.

"Good will cannot be bought or had for the mere asking. It must be deserved and must come as a reward for patient, devoted effort.

"We want the good will of every person in this city, and vicinity—man, woman and child.

"We cannot expect to win active good will in a few weeks or a few months. Within a reasonable time we shall demonstrate our right to the confidence which begets good will.

"The people and the Louisville Gas & Electric Company are partners.

"Among the tasks to be done in every city those of the public-utility organizations are among the most difficult—if not the hardest of all. We transact business every day in the year with the great majority of inhabitants.

"Our attitude is that of service in a spirit of partnership; that of wishing every person who pays us a dollar for service, more than a dollar's worth of value in return.

"If we succeed in adding to Louisville's growth and prosperity by adequate and low-priced gas and electric service, we shall be glad of the increased individual property values and the increased welfare of individuals.

"We realize that we have obligations to the people which cannot be ignored. We propose to discharge these responsibilities creditably and always in good faith and good will."

LOUISVILLE
GAS
AND
ELECTRIC
COMPANY
YOUR PARTNER
GOOD WILL
At this time when the subject of Good Will is emphasized in the mind of the world, it seems proper to discuss the good will which should and can prevail between the people and utility corporations.
Good will can not be bought or had for the mere asking. It must be deserved and must come as a reward for patient, devoted effort.
We want the good will of every person in this city, and vicinity—man, woman and child.
We can not expect to win active good will in a few weeks or a few months. Within a reasonable time we shall demonstrate our right to the confidence which begets good will.
The people and the Louisville Gas and Electric Company are partners.
Among the tasks to be done in every city those of the public utility organizations are among the most difficult—if not the hardest of all. We transact business every day in the year with the great majority of inhabitants.
Our attitude is that of service In a spirit of partnership; that of wishing every person who pays us a dollar for service, more than a dollar's worth of value in return.
If we succeed in adding to Louisville's growth and prosperity by adequate and low-priced gas and electric service, we shall be glad of the increased individual property values and the increased welfare of individuals.
We realize that we have obligations to the people which can not be ignored. We propose to discharge these responsibilities creditably and always in good faith and good will.
Louisville Gas and Electric Co.
GEO. H. HARRIES, President

Public Policy Advertisement of Louisville Company.

The advertisement is signed by George H. Harries, president of the company, who personally designed the trademark. The text was prepared by the publicity department of H. M. Byllesby & Company, Chicago, under the supervision of William H. Hodge, manager.

## New Plan for Financing "White Ways."

Red Lake Falls, a town in Minnesota, served electrically by the Red River Power Company, of Grand Forks, N. D., has evolved a new plan of financing a "White Way." A "White Way" ball will be given, the tickets to be sold at $5 each, and every public spirited citizen is expected to be present or at least purchase a ticket.

## Jacksonville Votes Against Municipal Ownership.

A bond issue in Jacksonville, Ill., for the purpose of rebuilding the municipal electric light plant, was defeated on December 20.

The Jacksonville Railway & Light Company offered to install four times as many lights as the municipal plant has in service, the price offered being less than the present cost of maintaining the municipal plant. An advertising campaign carried on by the company was devoted principally to setting forth the terms of the company's proposal, and the resultant advantages to the city.

The defeat of the bond issue is expected to mean the abandonment of the municipal plant, as it cannot be operated successfully in its present condition. This will result in the letting of a contract for the street lighting.

## Central-Station Service for Stock Farm.

The Public Service Company of Northern Illinois, Joliet, Ill., has recently closed a contract with the Stockdale Farm for 42 horsepower in motors. The installation serves what is known as a feeding farm. Sheep are shipped from the west to the farm, and are there sheared and fed for market.

The Stockdale Farm is a large one of its type, having a capacity for 30,000 sheep. A 15-horsepower motor will be used in the grinding room and the balance for pumping and shearing, and one 15 horsepower motor is to be used as a portable outfit for general purposes. Three gasoline engines were replaced.

## Electric Heating for Churches.

The electric heating installation of the Petrus Church, Christiania, Norway, has been completed. This is the first installation of its kind in Scandinavia, but others are to be installed. The electric heating of churches was first started about ten years ago in Germany and Switzerland, where it has proved satisfactory. The electric heating is effected by means of radiating pipes laid close to the floor, and the installation is said to be comparatively cheap. The price paid for current is only 0.8 cent per kilowatt-hour, the demand, of course, generally coming on at times of light load at the power station.

## Lehigh Company Moves Office.

The general offices of the Lehigh Navigation Electric Company will be moved from Lansford, Pa., to Hazleton, according to a recent announcement. The latter location is more adapted to the purposes of the company's offices.

# Electrical Construction

## INTERIOR WIRING WITH SPECIAL REFERENCE TO ITS EFFECT ON LIGHTING SERVICE.

By C. Edward Fee.

The activities of the electrical contractor constitute a very vital influence upon the progress and development of the electrical industry. You are in direct contact with the ultimate consumer of electricity. You know his needs as well as or better than anyone else. This makes it essential that you should direct your efforts to such considerations as would tend to give the consumers of electricity the most complete, most economical and most satisfactory service.

The service which the great majority of electric consumers desire, is lighting service, with the added desire for the use of the modern domestic and other electrical accessories which have done so much to popularize the use of electricity. The majority of the electrical contractors are co-operating to this end and are giving their customers the best possible service from every standpoint.

### Lighting Service as Affected by Voltage Drop.

The term "lighting service" may be used to designate the degree of satisfaction which a customer derives from the use of electricity as a means of producing light. Due to the high efficiency of modern electric lighting, the use of other illuminants is rapidly becoming less widespread than was the case a few years ago. The safety, convenience, adaptability and economy of such illuminants as the tungsten-filament lamp, for instance, have given a strong impetus to this branch of central-station service.

In electric lighting and particularly in incandescent lighting, as in no other one branch of the electric supply industry, satisfactory operation depends upon a very close co-operation of the voltage of supply and the rated voltage of the lamps.

The larger central stations maintain so-called "flying squadrons" who make periodic tests of the line voltage at the service switch on the premises of their customers. This enables the central station to maintain a fairly uniform voltage at the point where the service enters the premises of its customers. But this takes no account of the voltage drop between the service switch and the lamp sockets. An incandescent lamp fulfills its rated performance with respect to wattage, candlepower, and life only when burned exactly at its rated voltage. If the voltage supplied is less than the lamp voltage, its wattage consumption is decreased in a certain proportion and the candlepower in a much greater proportion, thus decreasing the efficiency of light production. If the voltage supplied is greater than the lamp voltage, the wattage, the candlepower and the efficiency are increased, but the life of the lamp may be unduly shortened.

As far as the quality of lighting service is concerned, if undervoltage burning exists, it makes no difference whether it is caused by the selection of an improper lamp or by lack of detailed knowledge of the exact voltage conditions existing on the system—the result is the same, less light, poorer quality of light, less revenue to the central station, dissatisfied customers and an opening for competing illuminants.

### Operation of Accessories as Affected by Voltage Drop.

The effect of a considerable drop in voltage on the operation of the various auxiliary electric appliances is somewhat similar to the effect on an incandescent electric lamp. In other words, the manufacturers of these appliances have established definite voltage ranges within which their operation will give satisfaction. The impression has existed that incandescent lamps require much closer voltage regulation than any other class of load, but it is found that various electric appliances (other than those motor-driven) require nearly as close voltage selection and voltage regulation as is necessary for the successful operation of lamps. Appliances of the heater class, such as flat-irons, curling-iron heaters, warming-pads, etc., are rated by their manufacturers in steps of from 5 to 10 volts, showing that the voltage limits for satisfactory operation are from 2.5 to 5 volts either side of the rating. Appliances of the cooking class, such as toasters, percolaters, grid-irons, broilers, etc., which demand somewhat closer temperature regulation, are rated in smaller steps of from 3 to 7 volts, showing that the voltage limits for satisfactory operation are from 1.5 to 3.5 volts either side of the rating. If the voltage supplied to the apparatus is lower than that at which it was intended to operate, the time required for producing the heat necessary for economical and successful accomplishment of the work in hand is too great. The result is, in many cases, a return to the earlier heating methods in use before electricity became economically and satisfactorily available. These close voltage limits in the ratings of appliances have been adopted by the manufacturers because they recognize that the economical and satisfactory operation of a majority of these appliances depends upon the time required to attain a certain heat and this in turn upon the voltage at which current is supplied. The importance of proper selection of apparatus with regard to the voltage at the point of attachment will therefore be fully appreciated.

### Object of Investigation.

In previous work on voltage conditions, the author found numerous cases where lighting service had been seriously impaired by interior drop. Some of the particular instances were so flagrant, and the resultant dissatisfaction with electric service was so great, that it seemed that an investigation of the subject of interior voltage drop might bring forth facts which would be of general benefit. The object, then, of this investigation of voltage drop between the service switch and the lamp sockets was to obtain, if possible, some information which would show an approximately average drop for various classes of lighting. Further, to show, in some measure, the importance of taking this factor into consideration in the selection of lamps and appliances for use on central-station circuits.

In securing locations for tests no attempt was made to select buildings which to the previous knowledge of the author might show abnormal conditions. The only criterion in the selection was the consent of the occupants of the building. It was attempted to include in the investigation such buildings as would be typical of the main classes of lighting load, such as industrial, commercial and residential. In order to eliminate from the data the effect of slight fluctuations of line pressure, it was necessary to take sim-

ultaneous voltage readings at the service switch and at the lamp socket. This was accomplished by the use of stop watches. Readings of the service voltage were taken every half minute, and all readings at lamp sockets were taken at times corresponding. The voltmeters used were very carefully calibrated, and any difference in their indications has been eliminated from the data.

Since practically all of the voltage measurements were taken during daylight hours, it was necessary to turn on the lamps during the test. An effort was made to avoid loading the circuits beyond the point which would be representative of the installation. In the case of residences the tests indicate load conditions somewhat heavier in comparison to the maximum demand than in the case of commercial and industrial installations. This is due to the fact that in residences the tests were made on the house as a whole, while in industrial and commercial installations separate tests were made on each floor or subdivision of the building. In the case of residential tests, the data on drop due to lighting load were supplemented by data on the drop caused by the addition of various appliances, such as flat-irons, toasters, heating pads, percolators, etc.

In residential service and particularly in apartments the number of risers from the services to the secondary distributing panels may be very small, hence, it might be expected that the average drop would bear some relation to the total load.

It is evident from the tables that a figure of at least two volts for the average interior drop indicates in a conservative manner the conditions which may be found throughout the country.

### Examples.

It might be interesting to note the extremes of conditions which were encountered in various tests. In one large residence which had nearly a kilowatt of lighting demand, the average of seven readings taken at various places about the house showed an average drop of only 0.7 volt. This was the only residence encountered which had separate and special provision for the conveyance of current to electric appliances. In contrast to this may be mentioned the case of a large residence in which a drop of 20 volts was found. The no-load voltage was 105 volts (using 110-volt lamps); with an 1,800-watt load the voltage dropped to 85 volts.

Another illustration of the effect of poor wiring is given in an article by C. E. Van Bergen, secretary and general manager of the Duluth Edison Company, Duluth, Minn., in the *Central Station* for July, 1911, part of which is quoted as follows:

TABLE I.—INDUSTRIAL SERVICE.

| No. | Description or product— | Maximum volts drop | Average volts drop | Total Lighting load. Kilowatts | 3-wire or 2-wire |
|---|---|---|---|---|---|
| 1 | Brass specialties | 9.4 | 4.1 | 5.3 | 3 |
| 2 | Lamp factory | 3.2 | 1.9 | 3.0 | 3 |
| 3 | Boiler and plate shop* | 5.5 | 3.1 | 11.2 | 2 |
| 4 | Machine shop | 3.8 | 2.1 | 6.1 | 2 |
| 5 | Foundry | 4.5 | 2.5 | 4.2 | 3 |
| 6 | Varnish | 2.0 | 1.7 | 2.2 | 3 |
| 7 | Clothing factory | 4.4 | 2.4 | 6.0 | 3 |
| 8 | Heavy castings | 9.2 | 3.4 | 4.8 | 2 |
| 9 | Plate and structural iron | 9.4 | 4.6 | 10.5 | 2 |
| 10 | Brewery | 6.5 | 4.5 | 4.7 | 2 |
| 11 | Machine shop | 3.8 | 3.1 | 3.1 | 2 |
| 12 | Machine shop | 4.3 | 3.2 | 9.1 | 3 |
| 13 | Stove factory | 6.2 | 4.2 | 8.3 | 2 |
| 14 | Box factory | 3.2 | 3.0 | 2.7 | 2 |
| 15 | Knit-goods factory | 3.3 | 2.2 | 4.2 | 3 |
| 16 | Fixture factory | 3.6 | 2.1 | 4.4 | 3 |
| 17 | Machine shop | 3.2 | 2.0 | 3.9 | 2 |
| 18 | Machine shop | 3.7 | 2.4 | 5.2 | 2 |
| 19 | Carding mill | 8.1 | 4.7 | 5.3 | 2 |
| 20 | Art glass | 3.5 | 2.1 | 1.2 | 2 |
| 21 | Awnings | 4.7 | 3.4 | 2.2 | 3 |
| | Average | 5.02 | 2.94 | 5.1 | |

*220 volts only.

TABLE II.—COMMERCIAL SERVICE.

| No. | Description or product— | Maximum volts drop | Average volts drop | Total Lighting load. Kilowatts | 3-wire or 2-wire |
|---|---|---|---|---|---|
| 1 | Wholesale hardware | 4.7 | 2.8 | 4.0 | 3 |
| 2 | Hotel | 4.9 | 2.9 | 1.0 | 3 |
| 3 | Hotel | 4.6 | 3.1 | 48.0 | 3 |
| 4 | Restaurant | 5.2 | 3.9 | 3.0 | 3 |
| 5 | Wholesale hardware* | 14.2 | 11.3 | 4.3 | 3 |
| 6 | Cigars and billiards | 3.8 | 2.7 | 1.2 | 3 |
| 7 | Wholesale hat | 3.0 | 3.3 | 0.6 | 3 |
| 8 | Office supplies | 5.3 | 2.5 | 12.3 | 3 |
| 9 | Office building | 5.9 | 4.3 | 60.0 | 2 |
| 10 | Restaurant | 2.2 | 2.0 | 0.5 | 2 |
| 11 | Restaurant | 2.5 | 2.2 | 1.0 | 2 |
| 12 | Club building | 2.9 | 2.0 | 3.2 | 3 |
| 13 | Small office building | 3.1 | 2.8 | 3.1 | 3 |
| 14 | Retail furnishing | 6.8 | 4.4 | 13.4 | 2 |
| 15 | Small theater | 7.2 | 2.2 | 3.4 | 3 |
| 16 | Storage | 2.1 | 1.1 | 2.7 | 3 |
| 17 | Storage | 2.9 | 2.0 | 4.4 | 3 |
| 18 | Department store | 3.9 | 2.2 | 7.7 | 3 |
| 19 | Small office building | 2.1 | 1.4 | 1.4 | 3 |
| 20 | Wholesale liquor | 3.4 | 2.9 | 1.3 | 3 |
| 21 | Retail glass and paint | 2.4 | 0.9 | 1.4 | 3 |
| 22—Garage* | | 21.0 | 20.0 | 2.7 | 2 |
| | Average | 3.94 | 3.03 | 10.9 | |

*Excluded from average, since these are evidently isolated cases of abnormal conditions.

TABLE III.—RESIDENTIAL SERVICE.

APARTMENTS.

| | | Lighting Load | | | | Increment due to Accessories | | |
|---|---|---|---|---|---|---|---|---|
| | | | Volts drop | | | | | |
| No. | Floor | Watts load | Maximum | Average | Average per kilowatt | Watts load | Volts drop | Volts drop per kilowatt |
| 1 | 2 | 475 | 2.2 | 1.3 | 2.7 | | | |
| 2 | 1 | 1000 | 2.7 | 2.0 | 2.0 | | | |
| 3 | 3 | 400 | 4.2 | 3.5 | 8.8 | 900 | 6.5 | 7.2 |
| 4 | 3 | 400 | 1.4 | 1.2 | 3.0 | | | |
| 5 | 4 | 300 | 4.4 | 3.7 | 12.3 | 990 | 7.8 | 7.9 |
| 6 | 1 | 420 | 1.4 | 0.9 | 2.1 | | | |
| 7 | 1 | 260 | 1.2 | 0.9 | 3.5 | | | |
| 8 | 2 | 350 | 1.8 | 1.4 | 4.0 | | | |
| 9 | 2 | 300 | 1.7 | 1.5 | 5.0 | | | |
| 10 | 1 | 475 | 2.4 | 2.2 | 4.6 | | | |
| 11 | 2 | 375 | 1.7 | 1.3 | 3.5 | | | |
| 12 | 1 | 735 | 3.2 | 2.4 | 3.3 | | | |
| 13 | 2 | 600 | 2.9 | 2.2 | 3.7 | | | |
| 14 | 2 | 425 | 2.1 | 1.8 | 4.2 | | | |
| 15 | 2 | 750 | 2.5 | 1.7 | 2.3 | 500 | 2.1 | 4.2 |
| 16 | 2 | 520 | 1.8 | 1.7 | 3.3 | 1000 | 7.5 | 7.5 |
| 17 | 2 | 260 | 0.8 | 0.6 | 2.2 | | | |
| 18 | 1 | 280 | 2.3 | 2.1 | 7.5 | 500 | 2.5 | 5.0 |
| | Average | 462 | 2.26 | 1.80 | 4.33 | 798 | 5.28 | 6.36 |

HOUSES.

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 1 | | 435 | 2.0 | 1.1 | 2.5 | 560 | 2.0 | 3.6 |
| 2 | | 600 | 1.6 | 0.6 | 1.0 | | | |
| 3 | | 1485 | 2.3 | 1.6 | 1.1 | 440 | 3.3 | 7.5 |
| 4 | | 440 | 1.7 | 1.3 | 3.0 | | | |
| 5 | | 400 | 1.2 | 1.0 | 2.5 | 1250 | 3.1 | 2.5 |
| 6 | | 525 | 1.2 | 0.9 | 1.7 | | | |
| 7 | | 640 | 1.0 | 0.8 | 1.2 | | | |
| 8 | | 475 | 2.0 | 1.7 | 3.6 | | | |
| 9 | | 960 | 1.5 | 0.7 | 0.7 | | | |
| 10 | | 345 | 1.3 | 0.9 | 2.6 | | | |
| 11 | | 860 | 0.9 | 0.6 | 0.7 | | | |
| 12 | | 685 | 3.4 | 2.7 | 3.9 | | | |
| 13 | | 500 | 1.5 | 1.0 | 2.0 | | | |
| 14 | | 825 | 4.3 | 3.1 | 3.8 | | | |
| | Average | 655 | 1.85 | 1.29 | 2.16 | 750 | 2.80 | 4.52 |
| Average for Residential Service— | | 547 | 2.08 | 1.57 | 3.38 | 767 | 4.35 | 5.68 |

"One of our customers made complaint the past winter of poor light, together with statement that the more lights turned on, the less illuminaion secured. Upon investigation, it was found that one circuit had only bell-wire in it, carrying six lamps, and as stated, one lamp gave fair light, while with six turned on, the filaments were only more than red. This house was wired over 20 years ago."

He also referred to the keeping of the matter of illumination before architects, "the tendency being ever to cut out and economize on this portion of building expense. An instance of this false economy came recently to our attention when we were asked to make an estimate on the expense of installing a heating circuit in a large residence only two years old. No provision had been made for baseboard outlets for the stand lamp in the reading room, and this lamp having been attached to the wall bracket, the bracket became loosened and presented anything but a pleasing appearance. Each new house should have provision made for a heating circuit on which may be used a luminous radiator, electric iron or a vacuum cleaner."

The customer's opinion of lighting service, as influenced by the matter of interior drop, may be illustrated by the case of a large garage. In this place the service had been changed from an isolated plant to that of the central station. At the time of this change, the proprietor replaced a number of 60-watt carbon lamps with 250-watt tungsten-filament lamps. The readings taken throughout this building showed that under the increased load condition, the average drop was 20 volts, with a maximum drop of 21 volts. This resulted in a loss of candlepower amounting to 50 per cent.

### Drop on Standard Wiring.

In Table IV are given some figures on the amount of voltage drop which may be anticipated on standard wiring. Columns 2 and 3 show for various sizes of wire the maximum allowable current carrying capacity and the resulting drop for a length of circuit which is assumed as an average for all classes of lighting installations, namely, 100 feet. Column 4 shows the drop for a current of 6 amperes, corresponding to a load of 660 watts at 110 volts.

TABLE IV.—DROP ON STANDARD WIRING.

| Size of wire. | Allowable current-carrying capacity, rubber insulation. | Volts drop when carrying maximum allowable current. | Per 100 feet of circuit when supplying 660 watts at 110 volts, i. e., 6 amperes. |
|---|---|---|---|
| B & S | Amps. | Volts | Volts |
| No. 14 | 12 | 6.05 | 3.02 |
| No. 12 | 17 | 5.40 | 1.90 |
| No. 10 | 24 | 4.78 | 1.19 |
| No. 8 | 33 | 4.14 | 0.75 |
| No. 6 | 46 | 3.63 | 0.47 |

### Conclusion.

The foregoing tables show that in commercial and industrial lighting installations, the average interior drop of three volts corresponds almost exactly with the maximum drop which could be expected if all circuits were of minimum size of wire and ran direct from the service. Due to lighter loads, residential lighting shows only about half as great an average drop.

Since the question of interior drop is not ordinarily taken into account in the co-ordination of the voltage rating of lamps and appliances with the voltage of the circuit, it is vital to the welfare of the electrical industry that this drop be kept as low as possible.

With this fact in mind, the author would recommend that a committee be appointed to confer with the Underwriters and see what steps can be taken toward securing the specification of No. 12 wire instead of No. 14 as the minimum allowable size for interior wiring.

## Revised Installation Rules.

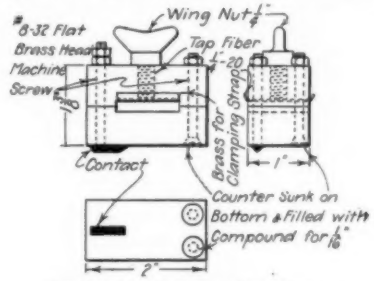
The Department of Water Supply, Gas and Electricity, New York City, has issued in printed form the 1913 Electrical Code, which is revised every two years for local use. While in the previous edition there were 110 differences between the City Code and the National Electrical Code, the present edition contains but 35 points of difference. Some of these are merely differences in phraseology, while others are due to local laws and a few honest differences of opinion, based upon experience in that city.

The Commissioner of Wires of Boston, James E. Cole, has issued the 1914 edition of the rules and requirements in that city for overhead, underground and interior wiring. The principal changes refer to inside work, designated as class C. A few changes have been made in the rules for underground and outside work, and a new section added, which requires transformers of ten kilowatts or higher capacities when installed upon poles to be suported by approved knee and platform construction.

The Underwriters' Equitable Rating Bureau, of Portland, Ore., has issued a second edition of "Wiring Data for Direct and Alternating-Current Motors." Changes have been made in some of the tables and additional pages have been added, including among other things data on copper conductors and wiring formulas. This booklet is supplied to persons outside of Portland for 20 cents, upon application to F. D. Weber, electrical inspector, P. O. Box 745.

## A Device for Testing Armatures.

Two sliding contacts are made of fiber, with two machine bolts for holding the parts together. Another bolt has a piece of brass soldered to it for the contact. On the other end of this bolt nuts are arranged for clamping leads for test. A wing-nut is used with a piece of sheet brass for clamping the belt. This belt has a buckle and suitable holes for tightening up and holding the contact device on the commutator. Loosening up the wing-nut allows contacts to be



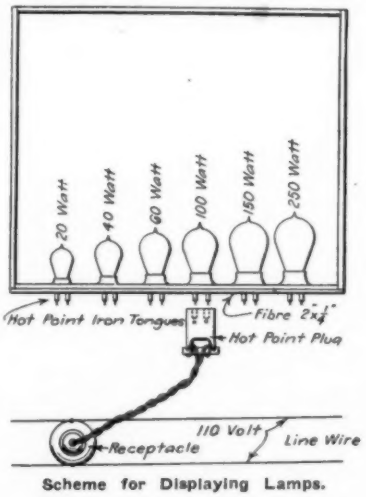

Device for Testing Armatures.

moved to any point around the commutator. The size of contacts shown is for fairly large commutators; for smaller sizes it is best to make up another set of contacts, making the contact and belt smaller. This device will stand very rough usage and I think they are almost indispensable in making tests with millimeter on armature or commutator.

H. W. Parsons.

## Case for Displaying Lamps.

The accompanying illustration shows a case made for displaying lamps in the sales department. Many customers, although desiring lamps, do not

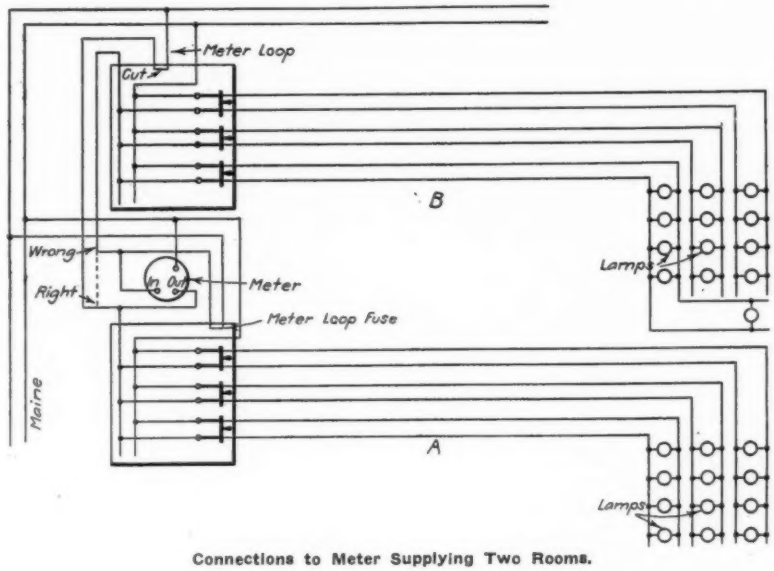



Scheme for Displaying Lamps.

know what size is wanted and have little idea how much light is given by the different sizes. With this arrangement the salesman can plug current on a lamp of any size without de-

lay and let the customer see the lamp burning. It works as simply as a telephone switchboard and saves much time. The front of the case is covered with plain glass and can be opened at any time to change lamps. The case is 38 by 38 inches and 6 inches deep, and the wiring is all concealed in this case, although it could have been run open.

M. J. Kenney.




Connections to Meter Supplying Two Rooms.

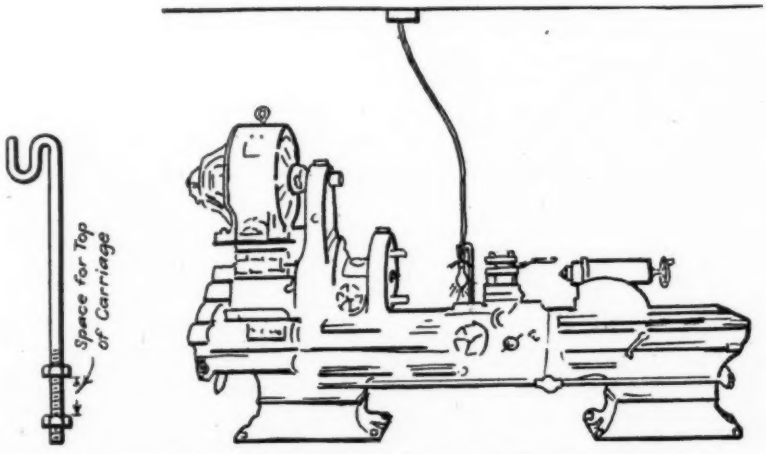
## Wrong Connection to Meter.

A case of trouble arose recently due to connecting the lamps in a second store to a meter already supplying one store room. When the lamps in one room were turned on, the meter ran forward, but when the lamps in the other room were turned on the meter ran backward. When the merchant decided to connect the lamps in the two different rooms to one meter the wireman ran two wires from the meter to supply the second room. The meter tester traced the connections through and found them to be as shown in the accompanying diagram. It will be seen that part of the current feeds through the meter and part flows around the meter so that the circuit is fed through both meter loops. In order to have the meter register correctly it was necessary to cut the loop, as shown in the figure, and to change one connection, as shown by the dotted line alongside the meter, thus permitting all the current to flow through the meter in the right direction and leaving but one feed wire.

H. L. Reagan.

## Lighting Lathe Work.

An all-around adaptable scheme for concentrating light on the cutting tool of a lathe has yet to be designed, but the accompanying illustration shows one successfully used in a particular case. A piece of one-half-inch iron rod is threaded on one end to accommodate two nuts and the thickness of the top of the carriage of the lathe next to the groove in which it slides. The other end of the rod is bent so as to afford a support for a lamp provided with a reflector. The lamp can be easily removed to look for tools, etc., and when in the position illustrated throws light directly on the tool with which it travels.




Detail of Rod for Holding Lamp, and its Position on Lathe.

H. G. Wilson.

## Transformer Cutouts Short-Circuited by Smoke and Dirt.

A transformer on a 2,200-volt circuit was mounted on a 40-foot dry chestnut pole and three secondary lines were run to a pole line, from which taps were taken and brought down to boxes near the ground containing switches and cutouts. I had occasion to remove the end pole on the secondary circuit and consequently had the fuse plugs pulled out on the primary side of the transformer, so that there would be no danger of having the secondary wires alive in case they should get crossed. Shortly after the plugs were removed, the man who had gone up the pole to untie the lines said that the secondaries were still alive. I then made sure that the fuse plugs had been removed and found them on the ground at the foot of the transformer pole, but the line man still claimed that the secondary was alive. By putting test lamps across the switch blades in the nearest box I found that they would light up.

The explanation is as follows. The transformer pole was located near a smoke stack of a low building where coke was generally used for fuel. The gases and smoke from this stack had thoroughly covered the porcelain cutouts in the primary circuit, so that there was a complete conducting circuit across terminals and current could pass regardless of whether the fuse plugs were in position. After installing new cutouts the condition was entirely changed. I later had the deposit on these plugs analyzed and found that it consisted of more than 90 per cent metal.

William E. Rhodes.

## Transformers with Motion-Picture Outfits.

The Commonwealth Edison Company has issued a circular letter to contractors calling attention to the fact that after January 1, 1914, the company will require the transformers used in connection with arc lamps for motion pictures or spot arcs to be wound for 230 volts. This is considered necessary to avoid interference with general lighting service.

## DON'TS FOR ELECTRICIANS.[1]

By H. M. Nichols.

Don't use open fuses.

Don't handle moving belts.

Don't use rotten belts.

Don't neglect storage batteries.

Don't overfuse circuits.

Don't allow belts to slip.

Don't throw water on burning oil.

Don't use acid salts in soldering.

Don't leave joints without soldering.

Don't put too much tension on brushes.

Don't put water on hot bearings.

Don't use emery cloth on brushes or commutators.

Don't fail to replace cracked insulators.

Don't step over, under, or through, moving belts.

Don't strip the threads on foundation bolts.

Don't use pliers with uninsulated handles.

Don't burn the insulation on wires, when soldering joints.

Don't burn contacts on knife switches, by opening them slowly.

Don't hang clothing or other material on wiring.

Don't use high-potential leads that are not properly insulated.

Don't leave tools lying near a motor or generator.

Don't expose electrical machinery or apparatus to moisture.

Don't use lubricating oil in transformers.

Don't use oil, in transformers, which has been exposed to moisture.

Don't put a motor or generator on a shaky foundation.

Don't run a booster without a speed-limiting device.

Don't install an outdoor circuit without a lightning arrester.

Don't do wiring without consulting the National Electrical Code.

Don't try to save wire by freak layout circuits.

Don't leave loose or dirty contacts on switchboards.

Don't forget the value of sand in fighting electrical fires.

Don't meddle with circuits you are not familiar with.

Don't run motors and generators without inspecting the bearing occasionally.

Don't put up wiring without the proper fuses or circuit-breakers.

Don't attempt to adjust series arc lamps with the current on.

Don't start a motor without making sure that the field circuit is all right.

Don't run a motor with a weak field.

Don't make adjustments on motors and generators when they are running; this applies particularly to brushes.

Don't bring a motor up to full speed too quickly when starting.

Don't send a new man on a job which he does not thoroughly understand; it is dangerous for all concerned.

Don't cut the blades on knife switches by adjusting the contacts too tightly.

Don't block up the space in front of switchboards so that the switches cannot be reached immediately.

Don't do high-potential testing, without first erecting red danger signs.

Don't get your face over commutators, as there is always danger of a flash over.

Don't handle meters roughly.

Don't expose your watch to heavy currents, if you expect it to keep good time.

Don't fail to read regularly at least one good engineering paper.

Don't run a motor or generator until the windings get hot enough to smoke.

Don't operate transformers without having the secondary windings grounded.

Don't discharge storage batteries too low, and don't let them stand when discharged.

Don't install conduit without grounding it.

Don't leave packing boxes and other inflammable materials in the power house.

Don't burn the contact buttons on starting boxes.

Don't use brushes that are not properly fitted.

Don't use both hands when working on live apparatus.

Don't leave joints without taping.

Don't fail to have a wiring diagram attched to each switchboard.

Don't run a belt with the tight side on top.

Don't run motor or generator with a loose pulley.

Don't use pulleys or couplings having exposed setscrews or bolts.

Don't neglect to fence in all exposed belts and shafting.

Don't allow dirt and oil to collect on the windings of motors and generators.

Don't use the back of switchboards for clothes racks.

Don't fail to treat every wire as though it were alive, until you have determined otherwise.

Don't stop motor without seeing that the rheostat arm falls back to the starting position.

Don't lean against machines or switchboards.

Don't open a main feeder switch, under full load, except in the case of emergency.

Don't fail to renew the oil occasionally in the bearings of motors and generators.

Don't use a rigid coupling where a flexible one can be used.

Don't connect alternating-current generators in parallel without first being sure they are in synchronism.

Don't run a motor or generator with loose pole-pieces.

Don't fail to ground lightning arresters.

Don't spill oil on the floor.

Don't store gasoline for blow torches in the power station.

Don't handle the blow torch carelessly around inflammable materials.

Don't neglect to remove temporary wiring.

Don't use copper wire to replace blown fuses.

Don't use plugs, for series arc switchboards having defective handles or frayed leads.

Don't forget that 500 volts, or less, is sometimes fatal.

Don't run a motor or generator which is vibrating badly.

Don't couple two machines together without making sure that the alinement is perfect.

Don't start a new motor for the first time without making sure that the armature turns freely.

Don't install rheostats and other sources of heat without separating them from inflammable materials.

Don't use wooden switchboards.

Don't drive nails where there is danger of their coming in contact with concealed wiring.

Don't put telephone or other signal wires above power wires.

Don't cut open a cable and leave it exposed to moisture.

Don't stop a motor by releasing the starting rheostat arm without having first opened the main switch.

Don't cut the strands in skinning the insulation from lamp cord.

Don't throw a switch unless you know positively to what circuit it is connected.

Don't leave oily waste in any place except metal waste cans.

Don't fail to use the proper-size starting rheostats for motors.

Don't allow a single-phase induction motor to run on the starting winding.

Don't neglect to run down grounds, and remedy them as soon as they show up on the ground detector.

Don't start a series motor without first making sure that it is properly loaded to hold down the speed.

Don't forget that there is danger of injury from short-circuits on low-tension wiring, when tools are handled carelessly around bare contacts.

Don't fail to consult the nameplates on motors and generators and make sure of having the proper voltage before putting them in service.

Don't start a motor by throwing in

1 From *Power*.

the main switch, without first seeing that the starting rheostat arm is in the off position.

Don't connect different makes of transformers in parallel without first making sure that the polarity is the same in both.

Don't open the field switch on a generator with the resistance all cut out of the control rheostat.

Don't forget that there is always a possibility of low-voltage wires becoming dangerous, by accidental contact with high-voltage wires.

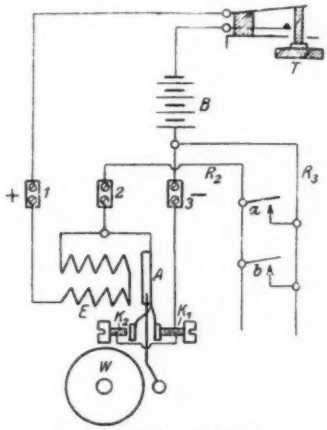
## Wiring System for Alarm Circuits.

In door-signalling installations for shops, signalling circuits in factories and other similar installations, it is usual to employ either wiping contacts—giving quite a short signal—or continuous contacts, yielding a signal which continues till the circuit is broken by, say, the reclosing of the door. In the first case the short signal given may easily escape attention, whereas in the second case the sustained signal is likely to prove a nuisance. Of the latter, readers have doubtless had many experiences in shops when a customer has entered and left the door slightly ajar. It is, of course, possible to provide a master switch by which the signalling circuit can be interrupted behind the counter or in any other convenient place, but this arrangement introduces the obvious risk that the attendant may forget to reclose the master switch, thus leaving the signalling installation inoperative.

In the Hydra system, described in *Electricity*, as translated from the *Elektrotechnischer Anzeiger*, this danger is overcome, while retaining the advantages and overcoming the disadvantages of a sustained signal, by the use of a special type of bell, which permits the ringing of the bell to be interrupted from any desired number of control points, while allowing the equipment to revert automatically to its operative condition directly the door is shut.

Referring to the accompanying diagram, when the door contact $T$ is closed, current flows from the negative terminal of the battery through $T$ to the bell terminal and thence through the bell magnet winding $E$ to the armature $A$, the contact screw $K_2$ and the positive terminal of the battery. The screw $K_2$ is so set that the bell circuit is interrupted before the current flowing reaches its maximum strength, and under these conditions the bell continues to ring in the ordinary manner so long as $T$ is closed. Should the signal be unduly prolonged for any reason, it is only necessary to press one of the buttons, $a$, $b$, etc. (of which any number may be placed wherever required). Current then flows through $a$ instead of $A$ and $K_1$ and the current no longer being interrupted before reaching its maximum strength, the armature $A$ is pulled in by $E$ until contact is made at the screw $K_2$. On releasing the push button $a$, the bell hammer is still held by $E$, and the ringing of the bell is suspended, although $T$ is still closed. When $T$ is opened, however (by the closing of the shop door in this case), $E$ releases $A$, and once this has occurred a fresh alarm is given directly $T$ is again closed.

By connecting a low resistance in series with a push button in parallel across $E$ it is possible, by pressing this master button, to demagnetize $E$ (even should $T$ still be closed), and on releasing the master switch the alarm signal will again commence should the shop door still be open. The resistance of the winding $E$ being 40 ohms, the current consumption is quite small whether the bell be ringing or whether ($T$ being closed) the bell is placed out of action by the means described above.




Wiring for Alarm Circuit.

It is claimed that two ordinary dry cells are sufficient to operate the Hydra system. Exactly the above arrangement can be applied to a variety of signalling duties, the contact $T$ being closed by a water-tank float, by a thermostat or by any other apparatus designed to indicate the actual state of a condition which has to be kept under control.

## Among the Contractors.

Contracts have been awarded to H. L. Dollahan & Company, of Dixon, Ill., for wiring and fixtures for the new Loveland School and for the new hospital addition in that city.

The Baird-Osterhout Company, 1112 Chestnut Street, Philadelphia, Pa., was awarded a contract for the electrical equipment in the Hospital for Criminal Insane, at Fairview, Pa.

The United Electric Construction Company, Philadelphia, Pa., was awarded the contract for installing a complete electrical equipment, including wiring for light and power, in the building of the Ford Motor Car Company, now in course of construction at Broad Street and Lehigh Avenue.

Hampton & Buerke, Tampa, Fla., have been awarded a contract to install a "White Way" at Boca Grande. This involves building two miles of a three-phase line. The electrical equipment at the Charlotte Harbor and Northern Railway terminal will be remodeled and transformers, with a capacity of 700 kilowatts, will be installed.

The Vedder Electric Company, Cleveland, O., has received the contract for wiring and installing electrical apparatus in a new four-story addition to the Taylor Arcade. The Cleveland Railway Company has also engaged the Vedder Company to wire and install apparatus in three new shop buildings now under construction.

The Guth Electrical Company, Perth Amboy, N. J., has been organized with a capital of $50,000 to engage in a general electrical business, including electrical supplies. Marius J. Dahl, Albert Guth and D. Guth are the organizers.

E. S. Thorne, electrical contractor of Coatesville, Pa., is installing the wiring, including electric clock, telephone and bell systems, in the Coatesville Graded School. The work, which is nearing completion, is in conduit throughout.

## Minneapolis Jovians Meet.

The members of the Jovian Order in Minneapolis, Minn., gave a banquet on the evening of December 30 at the Minneapolis Commercial Club, the guest of the evening being R. W. Babson. Mr. Babson made an address upon business conditions, which was illustrated by a number of charts. His investigations indicated that the point of lowest business depression was passed last September and that conditions are now improving.

He discussed the public ownership of public utilities and the relation of street railways to the investigation carried on by the Russell Sage Foundation regarding congestion in the large cities. He advocated extending the street railways beyond the points where traffic ceased to pay for them, for the purpose of making the open country more accessible to city people.

He advocated publicity in the banking business and then went on to describe a conversation with Thomas A. Edison, in which the latter had stated that of his inventions, the phonograph had brought him the greatest fame, motion picture films the greatest financial returns, while he himself regarded the electric lamp as the greatest of all.

# Dollar Wiring Kinks.

**Every reader is invited to contribute to this column. It does not matter how few words are used to explain a "Dollar Wiring Kink," provided the idea is made clear; and if a diagram is necessary, a rough pencil drawing will serve. The idea itself must, of course, be new and bright. A dollar will be sent to the contributor upon publication.**

### Telephone Head Receiver.

A very convenient method of utilizing a telephone head receiver for testing wiring and fixtures is as follows. Take an ordinary head set with four or five feet of cord connected, and cut one wire near the terminal on the receiver. Connect these two open ends to the two terminals of a flash-light battery. This battery is then taped to the head band and terminals are put on each end of the telephone leads for making contact to the circuit to be tested. The battery is then in series with the telephone receiver and upon connecting to any closed circuit a click will be heard.

Howard H. Douglas.

### Three-Quarter Conduit in One-Inch Box.

While doing a job with one-inch conduit I had junction boxes with one-inch knockouts. I had, however, to run some three-quarter-inch conduit for certain of

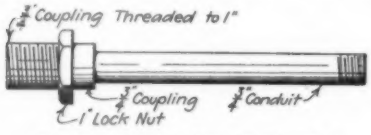



Fig. 1.—Showing Use of Coupling.

the lamps. In order to connect this into the boxes with one-inch holes, I threaded a three-quarter-inch conduit coupling which fitted in the one-inch hole all right. In many cases this will save time which would be wasted in waiting for a reducing bushing or in drilling a smaller hole in the box. It makes a satisfactory and solid job.

A. A. Vilter.

### Catching Dirt From Ceiling Outlets.

A kink has already been given describing a device attached to a bit for catching the dirt while working on a ceiling outlet. For over 30 years I have used a different scheme, which is to hang an umbrella upside down to the outlet. I always carry an umbrella along with my kit and find it useful for the above purpose as well as for customary use in rainy weather.

L. R. Payson.

### Hanging Fixtures Straight in Frame Building.

Fig. 2 illustrates how an electric fixture can be put up straight in a frame building. *A* and *A* indicate two pieces of conduit set in the floor beams, the top of the conduit being flush with the beams. They are screwed into a tee until they butt together. Into the bull-nose part of the tee a piece of threaded conduit *C* is screwed. This is long enough to come within one inch of the bottom of the floor beam. *D* represents the outlet box; *E* and *E* are two locknuts. *G* is the crowfoot or hanger. The outlet box can be raised or lowered as may be required in any particular case by loosening the locknuts and tightening them up when the fixture has been adjusted. This makes a good support for the fixture also.

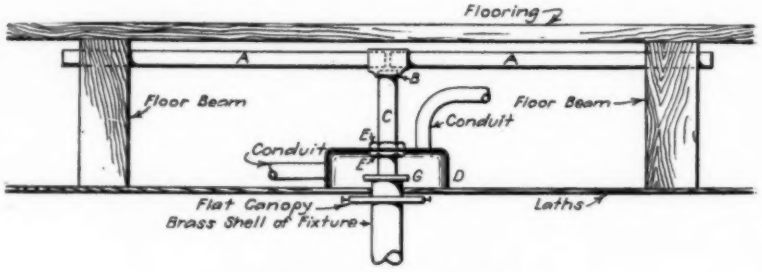



Fig. 2.—Method of Hanging Fixture.

William Weller.

### Soldering in Outlet Boxes.

Wiremen find it a difficult matter to solder joints in outlet boxes without dirtying the surrounding ceiling, owing to the burning of loose threads of braid. To remedy this I first do all splicing, pasting, etc. I then take a piece of stiff asbestos paper about eight inches square and cut a hole in the middle of it about the same size as the outlet boxes. When I am ready to solder I place this in position around the box and secure it to the ceiling by means of three or four drawing-board pins. These hold the asbestos in place very nicely if all work in the box except the soldering has been done beforehand.

John Short.

### Alarm for Chicken Thieves.

Fig. 3 illustrates a method of wiring a burglar alarm to catch chicken thieves who are familiar with ordinary methods. Take a tap from the house circuit through an eight-candlepower lamp (in order to limit the current on a low-voltage relay) and after passing through the relay run to a strip on the window casing, which is always in contact with another on the sash. Then put a contact on the window sill, which is in contact with the sash only when it is closed and from this run to the other lead wire in the house. Connect a battery and bell in series with the relay contact, so that the bell will ring whenever the current through the winding of the relay is broken. Run a third wire to the chicken house and connect to a contact, so that the circuit will be closed when the window is raised. The bell will then ring when the window is opened, even though the two main wires on the lighting circuit are short-circuited before the window is opened. With this arrangement the bell is rung if the house lines are cut or if the window is opened after short-circuiting them. If desired, a bell-ringing transformer may be used in place of the lamp in series with the relay, thereby eliminating high voltage on the bell wires.

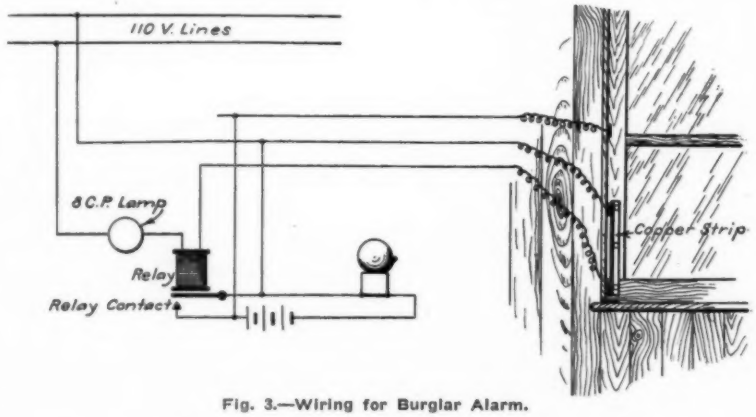



Fig. 3.—Wiring for Burglar Alarm.

E. V. Smith.

# Public Service Commissions

### ILLINOIS.

The Public Utilities Commission has been completed by the appointment of the fifth member, Owen P. Thompson, a former judge, of Jacksonville, Ill. The Commission met for organization on January 2, at Springfield, and conducted a hearing in Chicago on January 5.

### MASSACHUSETTS.

The public Service Commission of Massachusetts has approved an issue of 450 shares of common stock and 6,650 shares of preferred stock by the Massachusetts Northeastern Street Railway Company, at $100 per share. The proceeds of 4,150 shares of preferred stock are to be issued in exchange for $200,000 mortgage bonds of the Hudson, Pelham & Salem Street Railway Company; $145,000 of the Haverhill, Plainstow & Newton Street Railway Company; $25,000 of the Lowell & Pelham Street Railway Company, and $45,000 bonds of the Seabrook & Hampton Beach Street Railway Company. These properties are located in Northern Massachusetts and Southern New Hampshire. The proceeds of 2,500 shares of preferred stock and the 450 shares of common stock are to be used to pay floating indebtedness and for improvements and additions.

The Public Service Commission has disapproved of the construction of an electric railway by the Berkshire Street Railway Company to the summit of Greylock Mountain, on a location proposed by the company. The Commission says that the company might better expend the large sum required, over $1,000,000 as estimated, in the construction of extensions that would bring more benefit to the public through the development of territory for residential or agricultural purposes. The proposed line would penetrate the state reservation on Greylock, in Western Massachusetts, and would be in operation only in summer for tourist travel.

### NEW JERSEY.

The Board of Public Utility Commissioners has granted the Public Service Electric Company permission to issue $3,000,000 of its capital stock at par, the proceeds to be used for improvements and additions to the company's plants and system.

The Board has approved of an agreement between the Eastern Pennsylvania Power Company and the Delaware & Atlantic Telegraph & Telephone Company, providing for a joint-pole arrangement.

### OHIO.

The Public Utilities Commission has refused its consent to the purchase by the Bolivar Light & Power Company from H. L. Lash of the electric light plant at Bolivar. The reason given is that the price proposed is greatly in excess of the value of the property.

### WISCONSIN.

The Railroad Commission has authorized the Manitowoc Gas Company to increase its rate for gas from $1.00 net per thousand cubic feet to $1.05 net. The present value of the property was fixed by the Commission at $176,960 and the cost of reproduction at $205,456. The utility contended for a valuation about $225,000 in excess of that allowed, of which $130,800 was for going value. In refusing to grant an allowance for bond discount, the Commission called attention to the fact that the value of the bonds was in excess of the property by which they were secured and that they took the form of liabilities which had been outstanding. The rates authorized in the order will permit the utility to enjoy an adequate rate of return upon a fair valuation of the property concerned.

The city of Menasha has been authorized to extend its commercial lighting business and to substitute a graduated rate schedule, ranging from eight cents per kilowatt-hour to four cents per kilowatt-hour, for the present flat rate of six cents per kilowatt-hour.

The Milwaukee Electric Railway and Light Company has been empowered to issue $3,500,000, par value, of 4.5-per-cent refunding and extension mortgage bonds, to be deposited with the Bankers Trust Company as security for a similar issue of bonds carrying a higher interest rate.

The Commission has authorized the Green Bay Gas and Electric Company to issue $78,000, par value, of bonds to be used in discharging an existing indebtedness of $70,200. To enable the Wisconsin Public Service Company to acquire the property of the Green Bay Gas and Electric Company, authority has been granted the former to issue $78,000, par value, of five-per-cent bonds with which to purchase a like amount of bonds to be issued by the latter company. Authority to take over the remainder of the property will be made the subject of an order soon to be issued.

A new phase of public-utility regulation was manifested recently when the engineers of the Commission took temporary charge of the Neshonoc Light and Power Company's plant to determine whether the utility's contention that a sufficient increase in business could not be obtained to justify the expenditures necessary in complying with the Commission's past orders for improved service. Sufficient business was solicited to warrant the establishment of day power service with every prospect of its becoming profitable within a short time after its establishment. It appeared that past failures to extend the plant's business could be charged directly to a lack of faith and confidence in the management. As a result of the above investigation, the utility will be ordered to completely rehabilitate its plant and to make such additions and extensions as may be necessary to render adequate service both day and night.

## Enlarged Electric Plant for Manchurian Colliery.

The electric plant in connection with the three shafts at the Fushun coal mines in Manchuria had a capacity of 4,500 kilowatts, and the demand for current for operating the light electric railway has made it necessary to increase the capacity of the plant by 3,000 kilowatts. The installation of the supplementary power plant is almost completed. The electric railway mentioned will also be brought to completion in the near future, and it is expected that the new power plant will supply current in January, 1914. The increasing output of the collieries will necessitate the installation of additional power in the near future, and it is thought that a capacity of at least 13,000 kilowatts will eventually be required to operate the lighting system and provide the needed motive power.

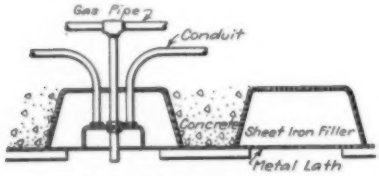
# Questions and Answers.

**All readers of the Electrical Review and Western Electrician are invited to submit questions and answers to this department. Full names will not be printed except where the writer indicates his willingness therefor. Anonymous communications will not be considered. Questions relating to electrical matters of any kind will be inserted. Answers from our readers should be received in this office preferably within ten days of the date of publication of the question, and will be published in a subsequent issue. Payment will be made for all answers published.**

## Questions.

No. 183.—Purity Test for Sal Ammoniac.—I would like to know a simple but accurate way to test sal ammoniac. I find that considerable of this material being sold is adulterated with common salt or other cheap chemicals. The burning test is not accurate enough. I would like to be able to test about what percentage of the test sample is pure sal ammoniac and how much of it is adulterated.—F. H. W., Brooklyn, N. Y.

No. 191.—Code Problems.—1. Should rule 59*f* of the National Electrical Code be construed to require all outlet boxes



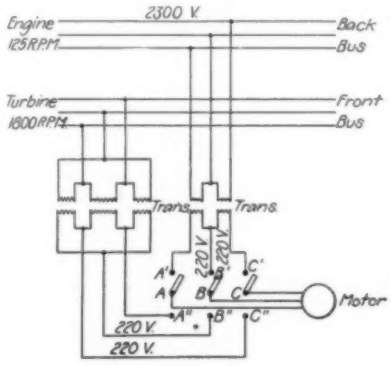

Support of Outlet Boxes.

to be independently supported? If so, I would like a few suggestions as to how it could best be done in the construction shown in the accompanying sketch, where sheet-iron fillers are used in place of tile and all outlets must be under these fillers, thus leaving no concrete to support the box.—2. Rule 28*f* states that gas pipes must be securely fastened in outlet boxes. How should this be done when the gas fitter merely drops a nipple through the box?—E. L. L., Bowling Green, O.

No. 192.—Gas Pipe as Neutral Conductor.—Some time ago I came across an installation where the electrician, instead of putting in another wire to make a three-wire circuit out of a two-wire circuit, used the gas pipe for neutral conductor. The customer complained to me that ever since this was done his electric bill has increased considerably. I would like to know if using a gas pipe as neutral (which, of course, is not permitted) would of itself cause increase in current consumption and, if so, why?—W. F., New York City.

No. 193.—Repairs to Spark Coils.—Is there any way to remove the wax so as to permit making repairs on the coils of a jump spark coil box, such as used on automobiles, without spoiling the finish of the wood?—J. F. P., Canton, O.

No. 194.—Motor Circuit. In operating a hot-well pump, we use a 220-volt three-phase motor, which derives its energy from a bank of three five-kilovolt-ampere transformers that are in turn fed from an outgoing power circuit. Any outside disturbance on this particular line would always drop the switch and consequently shut down the pump. In order to avoid this difficulty we used two transformers of 7.5-kilovolt-ampere capacity and which were fed from the back busbars, the leads being clamped to them. The secondary leads were run to the upper and lower terminals of a triple-pole double-throw knife switch, using the hinge terminals for the leads to the motor, as per diagram herewith. At the time of phasing out so as to keep direction of rotation the same, one turbine-driven generator was operating on the front buses, and an engine-driven generator on the back buses. In testing we used two 110-volt lamps in series and from terminal *A'* to *A"* there was no light, from *B'* to *B"* no light, and from *C'* to *C"* no light, but from *A'* to *C"* the two lamps burned dimly. We could not secure any light from any other connection. Thinking possibly that the dim




Circuit for Motor-Driven Pump.

burning of the lamps between *A'* and *C"* was caused by the generators coming up to synchronism, we inserted the plugs, but they were nowhere near that point, as the lamps on the synchronoscope and the instrument itself plainly showed. I have tried this over a great many times with the same result, which I cannot account for. Can some of your readers explain it?—R. J. H., Mason City, Iowa.

## Answers.

No. 175.—Two-Rate Meter.—Has any American central-station company employed two-rate meters for residences and other small customers connected to its miscellaneous lighting circuits? What method is used to change from the low rate to the high rate during the time of peak load and back agai..? What effect has this had on the peak? Is the time of high rate adjusted during the different seasons to correspond with changes in the station peak? Does the two-rate meter eliminate the need for primary and secondary rates based on maximum demand? What is the relative cost of a 10-ampere, two-rate induction meter compared with a similar standard meter? —V. P. B., Milwaukee, Wis.

(1) Yes; in fact, several types of two-rate meters are on the market and they seem to be gradually taking the place of the other meters in some places. (2) The two-rate meter as brought out by the General Electric Company is a regular Thomson recording meter provided with two dials and two recording trains. The meter is also provided with an electrically operated self-winding clock movement that throws either one or the other recording train into gear at whatever times the clock is set for. For example, the clock might be set so as to record on the lower-rate dial from 12 p. m. to 6 p. m. and then be switched over to record on the high-rate dial from 6 p. m. to 12 p. m. The changing over from one dial to the other is accomplished by means of two small friction clutches controlled by the clock. (3) In my estimation it would have no great effect on the peak. (4) The clock can be set to suit the company supplying this power and changed from month to month, when the meter reader makes his call. (6) Any company manufacturing meters will send price lists and descriptions of meters upon request, so that one interested in them can be given a better understanding as regards prices of the different types.—W. T. E., Seymour, Conn.

No. 182.—Searchlights.—Is a yellow-colored searchlight beam more penetrating on a foggy night than a white beam? What is the greatest distance that a searchlight has been seen on a clear night?—W. M. L., Baltimore, Md.

(1) Yes, if the other conditions, such ..s intensity of the light at the source and character of reflectors and lenses (if these are used), are the same in each case. The reason is that the small particles of solid matter, such as water, smoke, etc., constituting the fog have the property of refracting and dispersing the beam of light. The difference in the relative amount of dispersion of lights of different colors is due to the difference in wave-length of the various colors in the spectrum. In fact, it is the difference in wave-lengths which causes the effect which we call "color." The shorter the wave-length, the greater the refraction and consequent dispersion. The longest rays give the sensation called red; hence red light is least refracted. The next in order is orange, then yellow, green, blue, indigo and violet. The same order holds good whether the night be foggy or clear. (2) This is a difficult question to answer, since the curvature of the earth and the sea limits the distance any object or light can be seen. Hence the elevation of the light, as well as its intensity and color, affect the problem. Very feeble lights can be seen on the horizon at sea, as a matter of common experience. The writer made an exhaustive search for published data and the most striking instance found was, that in an article on the electrical equip-

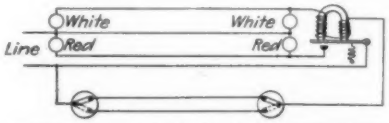
ment of the Lewis Publishing Company's building in St. Louis, appearing in the *Electrical World and Engineer* of November 12, 1904. In it is described what was then claimed to be the largest searchlight in the world with a parabolic mirror 80 inches in diameter and a positive cored carbon 2.25 inches in diameter and a solid negative carbon 1.75 inches in diameter passing a current of 300 amperes. It was located on a building 135 feet high, on rising ground which gave the lamp an elevation of 300 feet above the general level of the surrounding country. When directed downwards it was claimed that newspapers could easily be read at points three miles distant. When projected upward at an angle of 30 degrees, the beam was reported to have been discerned at points from 200 to 300 miles from St. Louis.—H. A. C., Pittsburgh, Pa.

---

No. 186.—Special Three-Point Switch Control.—A pair of white lamps in a hall is to be controlled by a pair of three-point switches, one at each end of the hall, but instead of turning the lights out a pair of red lamps is to light up when the white lamps are switched off. In other words, when either switch is turned it will merely change the circuit from the white lamps to the red lamps or the reverse, there being no "off" position to the switches. I would like to arrange such a circuit and want to know if it can be done and how?—J. C. M., Del Mar, Cal.

I would suggest accomplishing this as follows.

Connect one side of the circuit to one




Three-Point Switch Control Connections.

side of all four lamps, so that the side connected will be alive all the time. Connect the other side of the white lamps only to the wire coming from the three-point switches as regularly connected and connect in series in this wire an electromagnet so that when the white lights are off, contact is automatically made (through the dropping of the armature) with the opposite wire to light the red lamps. When the whites are turned on the reds will go off because the armature will be drawn up. The diagram shows the arrangement. The magnet coils must be capable of carrying the lighting current used and should be inclosed in an asbestos-lined box or cabinet so that possible arcing at the armature contact will do no harm.—H. P., New York City.

---

No. 187.—Wiring in Packing House.—I want to install the most approved system of wiring and up-to-date material in a packing house with very damp rooms and cellars. Which is best—iron-pipe conduit, lead-covered cable or flexible-steel conduit? It seems to me lead-covered cable would be best, as water can hardly be kept out of conduits and causes untold trouble. I should like to hear from some readers that have had experience in such work.—J. McQ., Cincinnati, O.

Wiring in damp locations requires the use of either rigid conduit or lead-covered cable properly protected against mechanical injury or, what is the same thing, flexible steel conduit with the wire therein lead-covered. When rigid conduit is used provision must be made for condensation to drain off, although this is small once the system is cooled and kept at the working temperature. The source of most of the water in the system is usually due to leakage at the fittings. Lead cable, and flexible with lead sheathing, must have the lead soldered at the outlets. All light and switch fittings should be the marine type, absolutely water-tight and kept so by rubber gaskets at all points where non-permanent joints have to be made in the conduit system. All joints in the conduit, when other than lead is used, must be made up with taper threads in place of the straight threads usually used in conduit work and the threads leaded or otherwise made water-tight.—W. M. P., Seattle, Wash.

Your querist seems to be aware that he is "up against" one of the most trying situations with which the electrical construction man has to cope. It is my opinion that in this particular situation, the use of what might be called "old-fashioned" materials and methods will prove to be the right solution. It is the "most approved and up-to-date materials" or at any rate those which have the approval of popular use today, which will lead the shortest and most unhappy career when subjected to the trials of packing-house life. Of course I refer, as does your querist, to the wet and steamy sections of the factory. Both rigid-metallic and flexible-metallic conduit, while admirably adapted to the protection of conductors in most situations are at a serious disadvantage when placed in the situation under consideration, for the simple reason that they are made of steel and will inevitably succumb to corrosion—natural and electrolytic as well. Only by reason of the most careful planning and execution by the most skillful and conscientious workmen, can such a job be made to put up a good showing when first installed, and deterioration is rapid and certain. It means tight joints, drained runs, no "traps" for water, and better insulated-wire splices than the average wireman can, or will, make. Lead-covered wires and cables, if properly installed, give some promise of permanency, but here again extra-high-grade workmanship is necessary, and the well-known frailty of the lead covering, its inability to withstand mechanical injury, is fatal. A very small puncture may be followed by a train of widespread and serious electrical troubles.

The use of iron pipe, or metallic conduit, as a raceway and protection for the lead-incased wires would seem to be an easy solution, and it is comparatively simple as far as mechanical protection goes, but its life is limited due to corrosion, as indicated above, and the difficulty of insuring permanent insulation in junction boxes and fittings, is as great, or greater, than with an ordinary installation of conduit and rubber wire.

Lead-sheathed conductors, with a flexible steel armor are no better, if as good, and this is a very difficult material to work. The writer favors open wiring on insulators, on account of the high initial insulation readily attainable, and more likely to be maintained. He would suggest the use of high-grade rubber-covered wire, carried on petticoat insulators where moisture conditions are most severe (the insulators to be installed in their natural upright position). Where appearance does not count and space permits, they should be mounted on impregnated wood pins in wooden cross-arms, elsewhere to be on malleable-iron pendent ceiling brackets. In less trying locations and where ceilings are low, use large porcelain knobs, mounted on wood cleats, saturated with moisture-repellant compound. Use for fastenings nothing but galvanized nails or screws; these, although not common, are easily obtained. In the matter of knobs, if the inspectors having jurisdiction possess the saving sense of humor, they will abrogate Rule 16*b*, and permit the use of solid tie knobs *throughout*, as well as "at the end of runs." If this consent can be secured, then use no knobs smaller than No. 4½, even for No. 12 and 14 wire, but compensate the inspection department for the concession, which is really a forward step and not a backward one, by applying two layers of friction tape for a space of six or eight inches, to the line wire at every insulator, before tying-in. Splices must be carefully re-insulated, using splicing compound well kneaded and united with the rubber, after the braid has been stripped back, then taped with friction tape and given a heavy coat of good insulating paint. Sockets should be of the vapor-proof globe type, suspended on stranded rubber-covered conductors. There is nothing novel or original about this construction. It has been described in detail in good illustrated articles in back numbers of this magazine, to which the editor can supply the needed reference. I firmly believe it is the best construction for the place under discussion.

The writer's reason for preferring solid knobs and petticoat insulators to split or two-piece knobs, is that since every insulating support is a point of leakage (a fact well known to all thinking electricians), then the reduction of

such leakage to its minimum should be the endeavor. A long leakage surface is necessary in wet places. This is assured in the highest degree by petticoated insulators. The next in efficacy is the solid knob with a long path down the base of the knob in one direction, and up over the head to the screw, or nail, in the other direction. The poorest design imaginable is the ordinary split knob which has a very short and direct path from the wire, across the crevice between top and bottom pieces, to the screw in which water collects and soon forms a bridge of rusty slime connecting the wire and screw, reducing the required separation of the wires of "one inch from the surface wired over" to zero.—C. A. H., Pittsburgh. Pa.

---

No. 189.—Number of Outlets per Circuit.—In the December 20 issue of the Review I see mention of a rule in Cleveland regulating the number of outlets per lighting circuit. Like most rules on this point it restricts the total load to 660 watts and also the maximum number of outlets to 12. Now where a circuit is arranged with nothing but 25-watt lamps and larger lamps could not be used satisfactorily, would it be permissible to run 20 of them on one circuit?—F. N. K., Maywood, Ill.

If the work was to be done according to the rules of the National Electrical Code, I should say that the use of more than 16 sockets dependent on one cutout would not be approved, except in the case of work done in theaters or moving-picture establishments when according to rule 38*d* footlights may have 26 receptacles, lamps not to require more than 1320 watts. Also there are some other exceptions that may be noted on reference to the book of rules, but I have been informed by an inspector that the rule for residence work is to have not more than 16 sockets or receptacles and the total load not to exceed 660 watts.—W. A. M., Cold Spring, N. Y.

---

No. 190.—Vehicle Batteries.—What number of cells is most commonly used at the present time for the storage batteries of electric vehicles? Is there likelihood of standardizing this so as to simplify the charging equipment and raise the efficiency of charging?—P. S. J., Rockford, Ill.

The number of cells which is commonly used at the present time for the passenger electric is 40, and that which is commonest for the commercial car is 44. There seems some likelihood of standardizing this number, namely 40, for all types of electric automobiles, though the principal reasons given for making 40 cells the standard are not logical. The reason given is on account of the fact that this number of cells is charged with the least $I^2R$ loss from the usual direct-current line. Inasmuch, however, as 95 per cent of all direct-current lines are 220-volt three-wire lines, any considerable current draw on one side serves to unbalance the line, and a more reasonable number of cells for any battery would therefore be such a number as could be most economically charged from 220 volts direct current, with least $I^2R$ loss in the rheostat, which would be either 80 or 84 cells. While such a standard would necessitate doubling the number of cells, the ampere-hour capacity could be diminished and it would be found upon mathematical calculation that a greater effective kilowatt-hour capacity would be available. This would be on account of the smaller loss in wires, brushes and motors.—R. L. L., Minneapolis, Minn.

## Suggestion Plan of Automatic Electric Company.

Fifty employees of Automatic Electric Company, of Chicago, manufacturers of automatic telephone apparatus, received tangible evidence of the company's appreciation of the helpful suggestions offered during the past year, when they were presented with watch fobs during a banquet given by the firm's employees on December 22, 1913.

Joseph Harris, president of Automatic Electric Company, made the presentations after thanking the men for the interest they had shown in their work, and also announced that the year 1913 had been the most satisfactory both in quality and volume of production, since the manufacture of automatic telephone apparatus began 22 years ago.

The fobs bear on the face a facsimile of the familiar dial calling device used in connection with the automatic telephone, with the initials of the recipient in the center. On the back are the words, "Presented by Automatic Electric Company for Helpful Suggestions, 1913."

The following employees received fobs: J. Turner, G. S. Rudolph, F. Voss, H. B. Perrott, J. Forrest, G. Green, J. Henning, A. Hopkins, G. Anderson, R. Ramsey, B. W. Johnson, S. Gross, J. Evers, J. Meyers, M. Larsen, A. Emmons, E. Jesse, C. Shay, R. Fisher, B. W. Freda, F. H. Borson, R. Stokely, H. Obergfell, A. Stannelle, T. E. Meyer, E. J. O'Brien, G. A. Meacher, R. Hughes, A. Bernsten, G. Henning, F. R. Quayle, J. J. Higgins, L. F. Wilke, S. E. Witt, E. C. Neumann, C. L. Martin, H. R. Wright, H. Thielberg, C. W. Hinman, Wm. Ross, C. Matthies, G. H. Ayers, J. Klusak, A. E. Wollny, J. J. Kain, H. F. Pfaff, B. Kindred, J. F. Probst and George Lawson.

About two years ago Automatic Electric Company started the suggestion plan, which is briefly as follows: A suggestion form is supplied to the employees, upon which all foremen are required to report at least once a week. They may send in one or a dozen such forms, but one is the minimum, and it must either contain a suggestion, or the words, "No suggestions to make this week."

The present plan is a modification of the original idea, under which suggestions were received at any time, but no weekly minimum was set. The result was that the men would forget it for weeks and this prompted the change.

When a suggestion is received, the factory superintendent notes it and refers it to an engineer, who makes an investigation, secures opinions from the employees affected, reports as to the changes in equipment necessary to put the plan into operation, and estimates the saving which will result. With these data the suggestion is returned to the factory superintendent for approval or rejection. A notice is then sent to the maker of the suggestion advising him of the action taken and of the reasons, if it has been rejected.

During the past six months, a further modification of the plan has been tried, whereby a special subject for suggestion during a certain period is announced. The employees are informed that while suggestions on any subject will be appreciated, special attention is invited to this particular theme. The following subjects have been dealt with in this way: Safety First; Water, Light, Power and Gas; Bonus Work; Care of Material; Inspection; Material and Finish; Scheduling Work, Chasing, Requisitioning and Transferring Stock.

Various ways of creating and maintaining an interest in the suggestion plan have been utilized. Reminders have been sent through the mail to all heads of departments; cards have been printed and fastened to the transmitters of telephones, while blotters, bearing a list of subjects for suggestions, have been distributed.

Very real benefits have flowed from the suggestion plan, for while Automatic Electric Company's plant was planned and systematized by efficiency experts of recognized ability, it has been found that "the man on the job" is often able to improve the details of the general system, thus materially adding to the efficiency of the methods employed, and eliminating many causes of waste and expense.

The suggestion plan has also had an additional value in giving the employees a keener interest in their work and in providing a useful channel for the criticisms always found among workers. The company has taken the attitude that present methods are not necessarily permanent ones, that better and quicker ways of accomplishing results are always in demand, and the reply to the often heard remark, "If I were the boss," has been "Tell us what you would do."

## Reversing Motor Drives and Automatic Control.

As chairman of the Shop-Practice Committee of the Association of Railway Electrical Engineers, George W. Cravens compiled and submitted before the recent convention of that association, some interesting data on motor drives and automatic control from which the subjoined notes are taken.

Among the many important changes in shop practice due to the widespread application of electric motors there is probably none of greater importance than those due to the application of automatic reversing motor drives to planers, shapers, slotters, etc. While a great many shop men appreciate the great saving in power and the increased production due to this practice, it is doubtful if the true importance of it is fully realized. Usually, the saving in transmission losses is the only thing considered and, even though this may be 50 or 60 per cent of the total power required, it is often only a small part of the real saving. The principal gain is in the increased production and decreased cost.

It is easily seen that the most efficient tool is the one which will do the most work in a given time without straining either the tool or the work; do it accurately and at the lowest cost for power and maintenance, and with the least loss of time between cutting operations. With tools that perform their work with a rotary motion of either the cutting tool or the work, such as lathes, boring mills and drills, it is possible to make the tool work 100 per cent of the time it is running, but with tools that operate with a reciprocating motion of either the cutting tool or the work, such as planers, shapers and slotters, a portion of the time is lost when returning between cutting strokes. So, the relation of cutting stroke and return stroke has an important influence on the amount of work that may be done in a given time.

With the direct-coupled automatic reverse drive the cutting and returning speeds are controlled independently, so it is possible to make the ratio between return and cutting speeds anything that may be desired, up to the practical limit. The speeds commonly employed for planing range from 50 to 100 feet per minute for the return stroke and from 25 to 50 feet per minute for the cutting strokes, the speeds depending upon the nature of the work.

From this it will be seen that the ratio between the return and cutting speeds will be 2 to 1, and motors giving this ratio are easily obtained. But, if a ratio of 3 to 1 is obtained there will be a gain of 12.5 per cent in time required to do a given amount of work, while with a ratio of 4 to 1 the gain will be 20 per cent. We find, however, that the latter is hard to obtain unless the planer is made heavy enough to stand this service, on account of the shock produced in accelerating and stopping the platen or table when the speed exceeds 100 feet per minute.

In order to reduce the cutting time to a minimum it is necessary to maintain as high a cutting speed as possible without injury to the work or to the tool, so the nature of the work must be taken into account. If the piece is small or sets low on the platen the speeds of both cut and return may be greater than if the piece is heavy or sets high above the platen. The weight of the platen itself must also be taken into account.

The reason a direct-coupled reversing planer drive is so effective is that there is no power wasted in intermediate belts, pulleys or shafts and there is no slippage. Since the power necessary to operate a planer or any other tool is the sum of the power required to do the work and the power used to overcome the friction and other losses in the driving mechanism, it is evident that, for a given job, a comparison of the no-load powers will show the difference between any two systems of drives. We find by a large number of comparisons that the saving made by using direct-coupled motor averages over 40 per cent. With a direct-coupled motor using dynamic braking, the most common method, the current used on reversals is less than with the shifting belt method because enough must be taken from the line, in the latter case, to stop the planer in addition to that required to start it and run it. With dynamic braking it is only necessary to use energy enough to start and run the planer, the energy developed in stopping the planer being absorbed in the motor armature and the resistances.

The cost of maintenance, where belts are used, must include the labor and material for repairing and replacing belts; labor and material for pulley, countershaft and bearing repairs; value of time lost while making repairs, if any; cost of general maintenance, oiling bearings, tightening belts, etc., and maintenance of motor and its controlling apparatus. When direct-coupled reversing motors are used the only item to consider is motor and control maintenance.

No accurate general figures could be obtained as to the time lost in production due to the use of belts, because the labor necessary to repair and replace belts varies so in different shops, but we know the productiveness of the tools is increased when reversing motors are applied because there is no belt slippage; no flywheel effect or inertia of pulleys to overcome; the cutting speed is adjustable to suit materials and cuts; the return speed can be adjusted to suit the work; no belts or countershafts are to be repaired, and a large amount of time is saved when setting up the work because the platen may be moved any required amount at will.

We have also found that where direct-coupled automatic reversing variable-speed motors have been installed on planers formerly equipped with belt drive the increased production averages 33 per cent. This means that if a shop has three planers and is so busy as to require a fourth one, the floor space and operating expense of the fourth can be saved by equipping the three existing ones with automatic reversing motors and controllers. The cost of three such equipments of medium or large size, for corresponding planers, will be about one-half that of the fourth planer, thus adding to the sum saved by the change.

The various makers have worked out variations in the details of their equipments, but all follow the same fundamentals; that is, the motor must accelerate, stop and start in the reverse direction, and the speed must be adjustable. The planer must also be protected in case of trouble on the power circuit, for if the voltage should go off while the machine is running the platen might run off the bed unless the motor stopped and held it. The essential parts of all control systems are three in number; a contactor panel, a master switch and a resistance.

### Automatic Control.

If it is true that one of the most important advantages of motor drive is increased output, it is equally true that motor control is also important, for it is only through proper control that increased output can be had. So long as a motor is no more than a driving element it is but very little better than a belt from a line shaft, but when that motor is made to vary in its action as required it then becomes a really valuable adjunct to any machine tool.

Nearly all of the power-consuming work done in machine shops consists in removing metals in the form of chips. That is, the output of any machine is generally measured in terms of the amount of metal it can remove in a given time. Hence, anything which will help a machine remove more metal in a day is a decided and very valuable improvement. It has been estimated that an increase of but 5 per cent in the output of the average machine tool will increase the earnings enough to pay back the cost

of applying the motor drive and control inside of two years. When the control of that machine is made as nearly automatic as possible, the gain is still greater.

A machine gives maximum output when worked at the highest economical speed and when operated on productive work the maximum amount of the time. Plenty of power must be supplied to and at the cutting tool and the speed must be variable over a wide range if the machine is to work at its highest economical speed at all times. Proper control and large motors are necessary to this end, and we find that a large number of railroad shops have been equipped in first class manner along both of these lines. In fact, we feel that it is along the line of adopting automatic control for machine tool motors that a very large part of the advance in shop practice will proceed.

Shunt-wound, adjustable-speed direct-current motors, or alternating-current motors of essentially those characteristics, are used for most machine tools, but they require suitable controlling apparatus before they are really satisfactory. Automatic control of a motor provides the limiting of the starting, stopping or reversing current to a predetermined value; starts, stops or reverses the motor in the proper amount of time protects the motor from grounds, short-circuits and commutator troubles, and limits the torque in the motor and in the machine it drives.

Automatic control not only relieves the operator from the physical acts of starting, stopping and reversing his motor but also relieves him from the mental exertion necessary to the proper regulation of a motor by a hand controller. He will seldom turn the handle at just the right speed, whereas the automatic controller gives him the fastest safe control and leaves him entirely free in mind and body for his part of the work. This not only makes the employment of a cheaper grade of labor possible, but all of the operations of control will be done in exactly the same way and in the same time, no matter how often they may be repeated after being determined.

In general, any system of automatic control, to be satisfactory, should provide for (1) the motor must start from rest and attain the speed corresponding to the setting of the field rheostat in the shortest safe time and with the current held within safe limits; (2) the motor must be reversed in the same manner and with the same automatic protection; and (2) the motor should be stopped by dynamic braking or any other similar and suitable method. Preferably this should be accomplished by means of push-button control when required.

Automatic control has been satisfactorily applied to machines with heavy inertia loads, such as punch presses, shears, bulldozers, forging and upsetting machines and others with heavy flywheels for both starting and stopping them. In place of clutches for connecting and disconnecting the motor and machine, the automatic controller allows of starting the motor quickly and safely and stops it by means of dynamic braking in the minimum of time. This type of control has also been applied to shapers, slotters and planers to good advantage.

One of the most important applications of automatic control in railroad shops has been to lathes and boring mills, as it allows the start, stop and reverse to be done from any desired point, and an electric brake may be used for quick stopping; friction drives may be replaced by positive drives; quick stops may be made for measuring and a large amount of time saved; the motor can be made to start only on the slow speed and then to quickly accelerate to the proper cutting speed, as predetermined; the motor can be made to automatically drop back to a safe current value in case of overload, and then come back automatically to the proper cutting speed after the overload has passed, and the operator can start and stop without disturbing controller.

The tendency in railroad shops is to demand automatic controllers which will protect both the motor and the machine from mishandling by careless operators and which will insure the doing of certain things in a certain time. Increased applications of motors demand the development of new controlling devices, and, conversely, the new controllers open up new fields of application for motors. This will result in taking the responsibility from the operator and placing it upon the electrician who installs the equipment and takes care of it.

An automatic controller is not so simple as a hand-operated device for the same service, and it is not always easy to take hold of one and install and operate it, but it must be done by all of us at some time, so let us find out all we can about the present state of the art before it is too late.

## Special Cooking Rate in Atchison.

The Atchison (Kans.) Railway, Light & Power Company has announced a reduction in rates to five cents per kilowatt-hour, effective immediately, for cooking purposes. The rate for lighting will be 10 cents per kilowatt-hour, as in the past.

## A CURRENT-LIMIT SWITCH FOR THE ACCELERATION OF DIRECT-CURRENT MOTORS.

By M. H. Erdmann.

Wherever direct-current motors of a larger horsepower than 0.25 are used it is advisable to use some sort of starting device to accelerate them, by means of which an external resistance in the motor circuit is gradually decreased until it is entirely cut out and the motor is receiving full line voltage at its terminals.

There are several methods of accomplishing this end, the original being to step-by-step short-circuit the external or starting resistance by hand. This method is more or less unsatisfactory when applied to motors above 10 horsepower (unless a competent man is employed to start the motors), due to the fact that there always exists the tendency to accelerate the motor either too rapidly or too slowly. If the tendency is toward too rapid acceleration the current drawn by the motor will be excessive and either the line fuses will be blown or the motor windings will in time burn out. On the other hand, if the motor be accelerated too slowly the starting resistance, not generally being proportioned for continuous duty, will burn out. If the starting of large motors is to be done manually it is highly imperative that an ammeter be placed in the circuit and that an educated electrical man be instructed to watch the ammeter while he is accelerating the motor so that the current drawn from the line will not reach a dangerous point and that it will not flow through the starting resistance for a long enough period to cause damage.

But it is not always expedient to have a good electrician available for the sole duty of starting motors. In some plants where individual motor-driven machines are used such a position would keep dozens of men busy all of the time. This is entirely out of the question. The most politic move for the motor users to make, then, is to install some form of automatic starting device on their several motors, by means of which the mere pressing of a button or the closing of a switch will cause the motor under the control of that one starter to be automatically accelerated in the shortest safe time consistent with the driven load.

This can only be done by means of current-limit acceleration; i.e., utilize the current drawn by the motor during acceleration to govern the proper length of time required to bring that motor up to its normal speed.

To obtain true current-limit acceleration it is necessary that the accelerat-

ing switches which will automatically cut out the starting resistance be constructed so as to adapt themselves for connection in series with the motor to be accelerated.

Fig. 1 is a cross-sectional view of such a switch. In this illustration *I* is the operating coil. This winding is carried by a brass tube within which the core *E* is free to reciprocate vertically. The upper end of the core *E* carries a non-magnetic stud to which is attached a copper contact plate *G*, adapted to make contact with a pair of contact brushes *H* when the circuit is closed. The lower end of the core *E* is reduced in cross-section and forms a stem *F* which meets the body of the core to form a shoulder. This stem *E* passes into a hollow plug *C*, which is of magnetic material. The winding

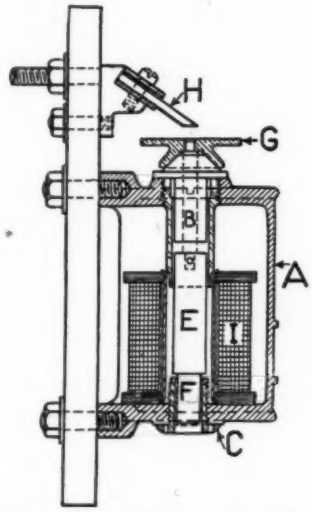



Fig. 1.—Cross-Section of Switch.

of the switch is inclosed and protected by a semi-cylindrical iron casing *A* which also constitutes the return member of the magnetic circuit. The upper member of the frame *A* is provided with a pole-piece *B* of magnetic material.

When current flows through the winding *I*, magnetic flux passes between the plug *B* and the upper face of the core *E*. Substantially, all of this flux is normal to the face of the core *E* and is effective in producing a magnetic pull tending to close the switch. At the lower end of the core, however, the flux has two paths. One of these paths is from the horizontal portion of the frame *A*, into the sleeve or hollow plug *C*, and from the upper face of this sleeve through an air gap to the shoulder on the core. This portion of the flux takes a direction practically normal to the face of the shoulder and produces a magnetic pull which tends to move the core downward, or, in other words, tends to prevent actuation of the switch. Through the second path at the lower end of the core a portion of the flux passes directly into the stem or extension *F* in a direction at right angles to the direction of motion, and this portion of the flux is therefore not effective in producing a pull on the core in a vertical direction. The total flux divides between these two paths inversely as their reluctances. With a small current in the winding *I*, substantially all of the flux passes directly into the extension *F* this path being of much less reluctance than the path including the air gap. This extension, however, is of restricted cross section, and as the magnetic force is increased the reluctance of this path increases and more and more of the flux is crowded into the air gap.

The core *E* is then acted upon by two forces—one the magnetic pull at its upper end which tends to close the switch, and the other made up of the weight of the moving parts plus the downward magnetic pull at the shoulder on the core. When the current is below a certain critical value, the upward pull is greater than the downward pull plus the weight of the moving parts, and the switch will close. When the current is above this critical value the downward pull plus the weight of the moving parts predominates and the switch cannot close.

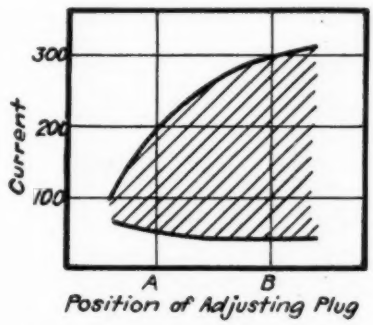



Fig. 2.—Operating Curves of Switch.

The critical value below which the switch will close and above which it will "lock out" is adjusted by screwing the plug *C* in or out, which adjusts the lower air gap. This has the effect of altering the reluctance in the path including the air gap with respect to the reluctance of the path including the stem *F*. Screwing the plug in and thereby shortening the air gap has the effect of decreasing the value of the current at which the switch will "lock out," while increasing the air gap has directly the opposite effect.

Fig. 2 is a reproduction of the operating curves of one of these switches. The ordinates of these curves read in amperes and the abscissas in fractions of an inch showing the length of the lower air gap.

The upper curve is the "lock out" curve, and the lower curve shows the minimum current at which the switch will close. The switch will close at any value of current between these two curves as measured on an ordinate corresponding to the length of air gap under consideration.

It will be observed that the lower curve is substantially a horizontal line, which shows that the minimum current at which the switch will close is very little affected by altering the lower air gap. After the switch has closed it is held closed by practically a closed magnetic circuit and will therefore be held closed until the current in its winding has fallen almost to zero. Since both the winding of the switch and its contacts are in the controlled circuit, the switch will not open until the current has fallen to nearly zero, it follows that there can be no arcing at the switch contacts, and hence blow-outs or other arc-rupturing devices are not required. With such a construction the friction of pivots and pins and that of flexible shunts is avoided and the switch acts accurately as a relay.

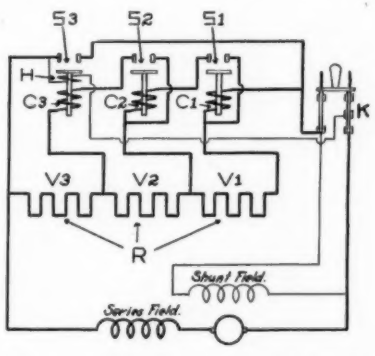



Fig. 3.—Connections of Automatic Starter.

A simple form of automatic starter employing series-wound switches to obtain current-limit acceleration and used in connection with a compound-wound motor is shown in Fig. 3. The starting resistance *R* is proportioned so as to allow only 150 per cent of full-load current to flow through the motor when it is in circuit immediately after the knife switch *K* is closed to start the motor. This current will "lock out" the accelerating switch $S_1$. As the motor gains in speed the current drawn from the line will decrease until the value is reached at which $S_1$ will close, short-circuiting the first section of resistance $V_1$ and at the same time energizing the operating coil of $S_2$. This will cause a sufficient rise in current to "lock out" $S_2$. Then as the current decreases again it will reach the value at which $S_2$ will close, cutting out a second section of resistance and energizing the operating coil of $S_3$. When $S_3$ closes the motor is connected di-

rectly across the line and is receiving full voltage at its terminals.

In addition to the regular operating coil, $S_3$ is also equipped with a shunt-wound holding coil $H$, which is supplied with voltage equal to the counter electromotive force of the armature, and which is designed to hold the plunger of $S_3$ up when it is once in the closed position. The magnetic flux produced by this coil is sufficient to hold $S_3$ closed but not enough to close it until the current in its operating coil has dropped to the value for which the switch is adjusted. When the knife switch $K$ is opened to stop the motor it opens the circuit to the shunt-holding coil, which, in turn, allows $S_3$ to open immediately, making it possible to close $K$ again to accelerate the motor before the armature has come to rest. If this provision were not made the starter would be very undesirable in case it should ever be required to accelerate the motor prior to the armature coming to a dead stop, for with $S_2$ in the closed position and the motor running at a low rate of speed, if $K$ were closed it would connect full line voltage across the motor's terminals.

## German Electric Furnaces for American Steel Concern.

An order has recently been placed by the American Iron and Steel Manufacturing Company, a Pennsylvania concern, with the Siemens & Halske Company, of Berlin, for two 20-ton induction furnaces of an improved type that has been developed from the combined patents of Kjellin, Roechling-Rodenhauser, and Frick.

These furnaces, which are now in course of construction, will be of the double-ring form and will be supplied with power from separate single-phase alternators. The generators will supply current at 5,000 volts. The normal power consumption of the furnaces will be 1,800 kilowatts each, and they will be employed for the refining of molten open-hearth steel, which will be used chiefly for the production of rails. The output of each furnace will be about 160 tons per day of 24 hours, depending upon the grade of steel produced. The importance of this order will be more thoroughly understood when it is considered that up to this time the largest furnace of this type had a capacity of only 12 tons per day.

**The St. Louis & San Francisco Railroad dismissed over 400 telegraphers just before they threatened to go on a strike. The telegraph has been abandoned as a dispatching medium and the telephone used instead.**

## LIGHTING OF STORE OF NEW CASTLE DRY GOODS COMPANY.

By Louis B. Round.

The interior illumination consists of 33 500-watt tungsten lamps in 16-inch Haskins globes, 12 100-watt lamps in 8-inch globes and 1,250 five-watt, 10-volt lamps arranged in the mezzanine floor, which in conjunction with the interior decoration of the building, presents a very pleasing appearance. In addition to these there are 180 25-watt tubular tungsten lamps on the show cases. The illumination of that part of the second floor used as display rooms consists of 25 250-watt lamps in 12-inch Haskins globes. The balance of the second floor and all of the third floor are given over to offices, of which there are 50.

Lighting of New Castle Store.

The windows are illuminated by 48 100-watt tungsten lamps, using Bailey reflectors concealed in such a manner as to reflect only on the goods and present a very pleasing appearance.

The outline lighting consists of 3,500 five-watt, 10-volt tungsten lamps wired on the three-wire system and supplied from transformers located on the roof, in addition to which there are 60 15-watt tungsten lamps around the portico and six tungsten posts containing five 100-watt tungsten lamps each. The conduit for the outline lighting was laid in the brick during construction, the lamps only being visible. They present a very pleasing appearance in the daytime and are especially beautiful at night, being visible for miles around. This was the first installation of outline lighting in this city, and since this time several other merchants have installed them.

The total connected lighting load is 52 kilowatts, wired on the three-wire system by the Modern Electric Company, of Wilkinsburg, Pa., under the personal supervision of Al. Keene. The fixture work was installed by The John Electric Company, of New Castle, Pa.

The total connected power load is 75.5 horsepower, in 220-volt, 60-cycle, two-phase motors, including one 40-horsepower and one 15-horsepower elevator motors. The balance are pumping, cash-system and ventilating motors, all of small capacity.

Both light and power are supplied from transformers located in a transformer vault in the basement, the service being carried into this vault in iron conduit and lead-covered cable at 2,300 volts and distributed from a main switchboard located in the sub-basement and about 10 feet from the transformers, thus insuring good secondary voltage.

All lighting and power is measured through 60-cycle single-phase Westinghouse watt-hour meters located on the main board, the average total consumption for three months being 7,400 kilowatt-hours per month.

It was the original idea of the owners to install a private plant but the representatives of the New Castle Electric Company had no trouble in proving the superiority of central-station service, M. A. Pooler, superintendent, securing the contract.

**The use of electric flatirons is very rapidly gaining popularity in England. In many tailor shops they are replacing gas irons.**

## ELECTRICITY SUPPLY OF LARGE CITIES.[1]

By G. Klingenberg.

Electricity is now universally acknowledged to be the most suitable form of energy supply for large cities, and apart from the convenience and reliability, its wide range of application makes it superior to gas, which 20 years ago had no competitor in this field. Although electricity was originally intended exclusively for lighting, its extensive application for power soon followed, and in many towns the power demand nowadays exceeds the lighting consumption. Electricity has introduced a radical change in the means of communication, by permitting the successful introduction of rapid-transit systems (underground and elevated railways) which are regarded as indispensable in large cities at the present day. A further field has been opened in its application to heating and cooking. The fact that electricity, notwithstanding its obvious advantages, has hitherto been unable to drive its competitors entirely out of the field, is solely due to the difference in price for the same amount of energy, necessitated by the cost in some of its forms of application.

Any reduction in price therefore results in its increased use, and it may be said without exaggeration that there would be no demand for other forms of energy if all electric supply undertakings would fully recognize the advantages which our present-day knowledge and experience places at their disposal, and furthermore, if they could rid themselves of the restrictions originally placed upon them in the supposed interests of the consumer, which restrictions are now very often found to be a hindrance to both consumer and producer.

It is the purpose of the present paper to explain the nature of these conditions and draw attention to those factors which would contribute towards a reduction in the cost of electricity and facilitate its more extensive employment.

Referring to existing conditions, I have confined myself to three examples which I consider to be typical. The material at my disposal enabled me to extend my investigations to details which will be of value when forming an opinion on the entire question. The cities selected are:

Berlin—Berliner Elektricitätswerke.

Chicago—Commonwealth Edison Company.

London—The municipal authorities and authorized supply companies in and around London.

The figures are based on the following years:

Berlin .....1911-12
Chicago .....1911
London .....1910-11

[1] Portion of address delivered before The Institution of Electrical Engineers in London, Eng., December 4, 1913.

### Berlin.

In Berlin the electricity supply began with the purchase and operation of generating sets by commercial undertakings solely for their own requirements, and without intention of selling energy to outside consumers. This system was found to be convenient as it was not necessary to lay conductors in the streets, and as complete independence of municipal authorities was possible. A number of these so-called "block stations" still exist, their combined output being estimated at nearly 40,000,000 kilowatt-hours.

The Berliner Elektricitätswerke alone formed an exception in this respect; they were intended from the outset to supply current to outside consumers. They were authorized to supply current outside Berlin on the condition that the city plants as well as those outside the city within a radius of about 20 miles could be taken over by the city authorities upon the expiration of the contract (1915). The tariffs are subject to the approval of the city authorities, who have decreed that the price at which the current is supplied must be reduced when the net profit exceeds 12.5 per cent on the capital. The city also participates in the profits, and receives 10 per cent of the company's gross income, and half the net profit after paying 6 per cent on the share capital up to $5,000,000, and again half the profit left after paying 4 per cent above this amount. The sum paid out in this manner during the past financial year, for example, was $1,650,000, which considerably exceeded the dividend paid on the company's share capital of $15,000,000. The development of the Berliner Elektricitätswerke may be seen from the following figures for the energy sold:

1900-1, 69,700,000 kilowatt-hours.
1905-6, 126,200,000 kilowatt-hours.
1910-11, 192,100,000 kilowatt-hours.
1912-13, 244,300,000 kilowatt-hours.

Although the city has formally notified the Berliner Elektricitätswerke of its intention to exercise its rights to take over the whole concern in 1915, no definite decision has yet been reached.

The distribution in Berlin is on the direct-current system throughout with the exception of the suburbs and a section of the city in the north, which are fed directly with three-phase current.

Apart from the Berliner Elektricitätswerke and the above mentioned block stations, a number of separate traction power stations exist, which supply energy to the underground railways and a part of the tramway system.

### Chicago.

The Chicago electricity supply originated in a large number of small supply companies (approximately 36) which were amalgamated between the years 1892 and 1906 to form two large companies: The Chicago Electric Company, and The Commonwealth Electric Company. In 1907 these two companies were amalgamated under the title, The Commonwealth Edison Company.

All the small power stations have been shut down since then, and the whole supply is obtained now from four large power stations.

The concession extends over a period of 50 years, dating from the year 1897, and it stipulates the maximum rates to be charged by the company, and a payment of 3 per cent on the annual gross receipts to the city.

The development of the company may be seen from the following figures for the energy sold:

1900, 33,790,000 kilowatt-hours.
1905, 93,000,000 kilowatt-hours.
1910, 550,000,000 kilowatt-hours.
1912, 712,000,000 kilowatt-hours.

The substations are fed with three-phase current at 9,000 volts, 25 cycles, and in part at 20,000 volts, 60 cycles. The distribution in the interior of the city is on the direct-current system, while in the outlying districts three-phase current at a frequency of 60 cycles is adopted.

### London.

If I understand the history of the electricity supply in London correctly, it began, as in the case of Chicago, with a number of private companies. Their development was hampered, however, in the earlier stages by legal restrictions which limited the concessions to a period of 21 years, and divided the current supply of the city into a number of districts corresponding to the administrative divisions, without taking into account the natural development of the distribution system. Every authorized supply undertaking was obliged to erect its own generating station and to lay out its own distributing network. An amalgamation of the different concerns was therefore out of question until in 1908 the original act was modified by a new law. Since that time constant endeavors have been made to combine the numerous companies, to centralize the generation of energy, and to standardize the different distribution systems as far as possible.

### Discussion of the Factors Determining the Cost to Consumers.

It has already been mentioned in the introduction that the development of the electrical industry in large cities is chiefly dependent upon the price of the electrical energy, and I now propose to discuss the factors which determine this price.

*Cost of Plant.*—The specific cost of the plant, i.e., the cost per installed kilowatt, should be mentioned in the first instance. As each kilowatt installed is only capable of supplying a given number of

kilowatt-hours, the increase of cost will be in proportion to the capital expenditure per kilowatt, provided that other conditions remain unaltered.

A distinction must be made here between the costs for the power station and for the network. In the power station the cost per kilowatt decreases rapidly as the size of the generating sets increase. This applies the more the generation of the energy is centralized in large power stations. For works with modern generating sets of 1,000-kilowatt capacity the installation costs are found to be approximately $75 per kilowatt, whereas for units of 20,000-kilowatt capacity they only amount to one-half of this sum. Bearing in mind that for large cities outputs of several one hundred thousand kilowatts are required, one will realize that units of less than 20,000-kilowatt capacity are unsuitable and too expensive for this purpose, and the installation of 30,000-kilowatt sets appears to be fully justified. In consequence of this development the specific cost of power stations has fallen in about 10 years to nearly a quarter of its former value.

The conditions are not so favorable, as a rule, for the network. When the energy transmitted is increased by using cables with larger sectional areas, the economic limits are soon reached, since the permissible specific load on the conductor, and therefore its effective utilization, decreases as the sectional area is increased. On the contrary, the idea of extended centralization has the reverse effect on the cost of network, since these costs are increased by longer feeder cables without any direct gain being secured in the network itself.

It is, nevertheless, also possible to economize on the capital outlay of the distribution system. In this connection the use of higher working voltages should first be mentioned. The customary feeder cables for pressures of 6,000 to 10,000 volts no longer meet present-day requirements in large cities. The additional cost of transforming when the cable pressure exceeds 10,000 volts is counterbalanced even in the case of short distances by the saving effected in the cables. Whenever extensions are contemplated, pressures of 20,000 to 30,000 volts should be adopted, even should this entail a further transformation at some points where stations with different pressures have to be connected up.

At the above pressures it is possible to transmit outputs of more than 10,000 kilowatts through one cable. The cost of the feeder cable is reduced to about 60 cents per kilowatt transmitted and per kilometer, so that this part of the installation cost becomes of less importance for the short distance over which the energy has to be transmitted in cities.

A further means of reducing the cost of the network is found in the conversion of the entire system to a uniform alternating-current system, by laying ring mains and by interconnecting the various sections of the city.

*Charges on Capital.*—The determination of the price for the current should be preceded by the fixing of the rate for capital charges which must be regarded as the minimum for the prosperous development of the undertakings in question. In many instances the low rate of interest forms an obstacle when new capital is required, it prevents the concern from adopting progressive measures for improving the economy of the plant, and indirectly keeps the cost of the current unnecessarily high. On the other hand, it will be agreed that an undertaking which has to make use of public streets and thoroughfares, and is granted certain privileges by local authorities, is under an obligation to consider the interests of the general public in addition to its shareholders' interests.

The demands of the authorities, however, have unquestionably on many occasions exceeded reasonable limits, and by hampering the entire undertaking have impeded rather than assisted public interests. In my opinion, interest at 6 to 8 per cent on the value of the plant represents for undertakings of this kind the lowest limit which would ensure a favorable market for the company when it requires further capital. As regards the sinking fund and other reserves, an average figure of 3 to 4 per cent seems to be reasonable for power stations, substations, and distribution system; for long-distance transmission lines and feeder cables in which the conducting material (copper) represents a high percentage of the total value, about 2 per cent may be sufficient. I have therefore based the following calculations upon uniform capital charges of 10 per cent for power stations, substations, and distribution system, and 8 per cent for transmission lines and feeder cables, and I have called the current prices calculated from this basis "normal prices."

*Cost of Operation.*—The direct operating costs affecting the price of electricity chiefly consist of the following items: coal, stores, wages, repairs, taxes, insurance, and general expenses such as wages, management, office costs, etc. The costs resulting from the losses between the power station and the point of consumption must also be included here.

The costs of generation are directly dependent on the size of the power station, or on the size of the generating sets. Power stations with units of 20,000-kilowatt capacity consume only about three-quarters of the quantity of coal at full load compared with works in which modern 1,000-kilowatt sets are installed, and only half or even less of that consumed in older power stations with units of this size. The operating staff required depends chiefly upon the number of machines and not upon their size, this being all the more the case in modern power stations in which human labor is replaced wherever possible by automatic machinery. Therefore labor costs are far more favorable in plants with large generating sets. The same applies to the sums required for repairs, stores, and general expenses.

The operating costs for the network are not directly dependent upon the size of the undertaking. By subdividing the distribution system in accordance with the best engineering practice, by simplifying the organization and by standardizing the plants, one can effect economies. Here again attention should be drawn to the superiority of the alternating-current systems over the mixed systems.

*Transmission Losses.*—The transmission losses, which in the old plants amount to about 20 per cent of the energy generated, and thus represent from 10 to 15 per cent of the selling costs, can unquestionably be reduced to half this figure with the enlargement and standardization of the plant, this being all the more the case in view of the fact that lower generating costs also reduce the cost of the losses.

*Utilization of the Plant.*—A comparison between different plants and the prices at which they sell their current is only possible when the extent of their utilization is known.

By the term "utilization" I mean the ratio of the kilowatt-hours sold within a given period (usually taken as a year = 8,760 hours) to that number of kilowatt-hours which the plant would have been capable of generating if all the machines had been running constantly at full load during this period.

The utilization of the plant can thus be expressed by the following formula:

$$u = \frac{\text{kilowatt-hours sold per annum}}{\text{installed capacity of plant} \times 8{,}760} = \frac{\text{average load sold}}{\text{installed capacity}}$$

This term has been in use for some years on the Continent. I have called it the "utility factor" ($u$) of the plant. The following particulars will show that the use of this factor affords valuable assistance in arithmetically following up the somewhat intricate relations between the cost of the current and the utilization of the plant.

In determining these functions it is necessary to ascertain the current costs (or proportionate current costs) both

for the entire plant and parts of it when working permanently at full load, these values being characteristic and practically constant for each individual plant.

With regard to the capital charges (interest, dividends, sinking fund, etc.) this value ($A_s$)is obtained by dividing the annual interest by the product of the total capacity and number of hours per year. If, for example, the capital charges are $K_s$ and the total capacity of the plant $L$ kilowatts, the characteristic value for the capital charges is given by the formula

$$A_s = K_s/8760L.$$

The capital charge per kilowatt-hour sold is $A_s/n$.....(1)

In a similar manner one can show how the direct-operating costs (coal, repairs, wages, etc.) depend on utilization. Here, however, the characteristic costs per kilowatt-hour for full load are partly independent of utilization. The relation between utilization and operating costs can then be found from the expression:

$K_b = a_b/n + b_b$ per kilowatt-hour sold..(2)

It can be shown that the value $a_b$ represents those costs which would be entailed if the plant had to be kept ready for service without supplying useful energy; in other words $a_b$ are the no-load costs. The recognition of this fact enables the values $a$ and $b$ to be separated. Thus the proportion of the running costs to the current selling price can be determined for any utilization in accordance with equation (2).

In determining the value $a$ (no-load consumption) for the fuel of the power station, the time during which each set is run must be taken into account. It can be shown that this is done with sufficient accuracy for practical purposes by making the following modification of equation (2):

$K_k = (n+1)a_k/2n + b_b$ per kilowatt-hour sold .....(3)

The transmission losses may be expressed by a similar formula on the assumption that the copper losses, which really vary as the square of the load, are supposed to be proportional to the latter. This simplification appears to be permissible, since the costs for losses only form a small part of the total costs.

The total selling costs per kilowatt-hour are thus found to be equal to the sum of proportion of costs referred to the power station including capital charges; proportion of costs for the transmission and distribution losses including capital charges; proportion of costs for the operation of the transmission system including capital charges.

They can be represented by a single equation:

$K = 1/n + a/n^2 + b$ per kilowatt-hour sold ..... (4)

which is called the costs characteristic for the entire plant. With this equation one can ascertain the average energy costs for the entire plant, and one can also graduate the prices payable for the various classes of consumption in correct steps as soon as their individual influence upon the utility-factor is known.

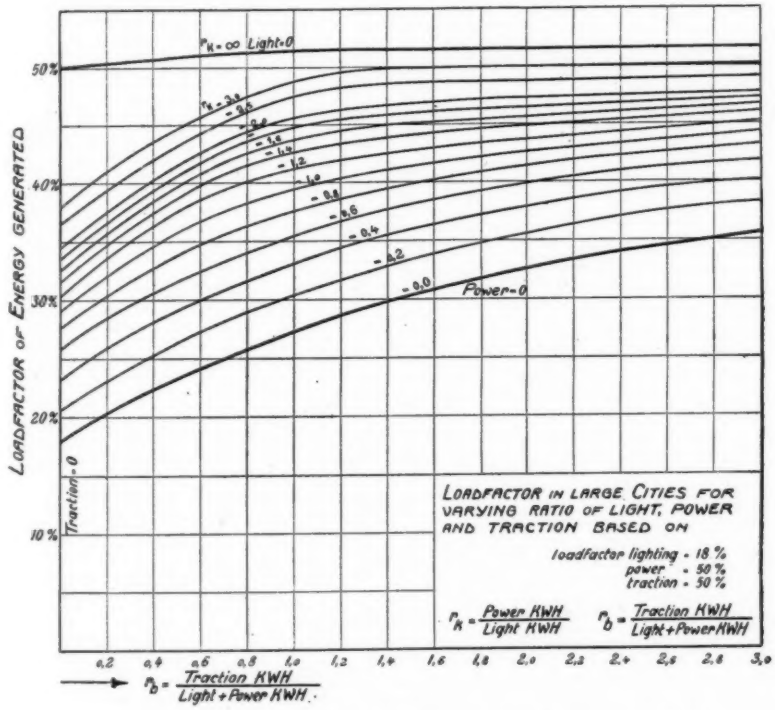

LOADFACTOR OF ENERGY GENERATED
50%
40%
30%
20%
10%
$r_k = \infty$ Light-0
Power-0
Traction-0
LOADFACTOR IN LARGE CITIES FOR VARYING RATIO OF LIGHT, POWER AND TRACTION BASED ON
loadfactor lighting - 18 %
power - 50 %
traction - 50 %
$r_k$ = Power KWH / Light KWH
$r_b$ = Traction KWH / Light+Power KWH
0.2 0.4 0.6 0.8 1.0 1.2 1.4 1.6 1.8 2.0 2.2 2.4 2.6 2.8 3.0
$r_b$ = Traction KWH / Light+Power KWH

Fig. 1.—Curves Showing Effect of Character of Load Upon Load-Factor.

*Determination of the Utility-Factor.*—In view of the importance of the utility-factor in connection with the selling price of the current, I now propose to discuss those points which determine the value of this factor.

One of the first points to be considered in this respect is the load-factor, $m$, which is given for the entire plant by the ratio between the average load of the power station and the peak load. This value is proportional to the utility-factor.

Whereas in small plants irregularities in the consumption are perceptible in the power station, and the load-factor in such stations may be affected by a single consumer; in large stations load fluctuations are equalized as the size of the plant increases. It is therefore possible to determine the form of the load curve, and therefore load-factor, for large plants with sufficient accuracy from the outset, provided the general nature of the consumption is known. Leaving out heating and cooking, three principal classes of consumption remain: power, traction, and lighting. Each of these classes possesses a special load curve which is similar in all large cities, and only varies for lighting according to the latitude. Whereas the power and traction load curves remain approximately constant throughout the whole year (with the exception of Sundays), the lighting load varies according to the season, so that both the average annual load and the maximum load in winter must be known, in order to determine the load-factor. Characteristic load-factors are, excluding Sundays, for light, 18 per cent; power, 50 per cent; traction, 50 per cent.

From standard curves we can obtain the resultant load curve and also the resultant load-factor $m$ for any desired combination of light, power, and traction consumers.

From Fig. 1 the resultant load-factor can be taken directly as soon as the percentages for power, traction, and lighting are known. If, for instance, the kilowatt-hours consumed comprise 20 per cent lighting, 12 per cent power, and 68 per cent traction (this approximately resembles the conditions in Chicago for 1911) then the resultant load-factor lies at the intersecting point of the curve

$$r_k = 12/20 = 0.6,$$

with the abscissa value

$$r_b = 68/(12+20) = 2.13,$$

according to which a resultant load-factor of 40 per cent for the above relationship may be expected and which approximately corresponds to the actual value obtained, namely 41 per cent.

This diagram demonstrates the important fact that by superimposing power and traction curves (top curve, $r_k = \infty$) the

load-factor may be improved only by 2 to 3 per cent, while on the other hand by combining the power and traction supply with a lighting load of about 12 per cent, the resultant load-factor is materially decreased.

Next to the load-factor, the efficiency of the network has to be taken into account in determining the utility-factor. This efficiency is expressed by $\eta$, and is the ratio of the kilowatt-hours sold to the kilowatt-hours at feeder busbars.

This value again is in direct proportion to the utility-factor.

So far as the selling price of the current is concerned, this means that the improvement of the distribution efficiency not only produces a saving in costs for losses, but also (through the increase in the utility-factor) causes a reduction of the remaining costs.

The third point is the amount of stand-by; the utility-factor being inversely proportional to the capacity of the stand-by. Although it is difficult to express any rule for the percentage of stand-by to total plant, this percentage can be reduced with the increase in size of the total plant. This is mainly due to the fact that in the smaller stations the load curve is subject to more violent fluctuations. Therefore, in addition to stand-by for overhauling and repairs, reserves are required to meet such variations in load. The stand-by factor $r$ is the ratio of installed output to peak load in station, where the decimals indicate the percentage in spares. The relation between utility-factor, load-factor, distribution efficiency, and stand-by is given by the formula:

$$u = m \times n \times I/r \quad \ldots\ldots\ldots\ldots\ldots\ldots (5)$$

By inserting this value in equation (4) for the cost characteristic of the plant, the influence of any of the above factors upon the cost can be ascertained.

In view of the important effect on the utility-factor resulting from a combination of various classes of consumers, a few remarks should be made here bearing upon the practical possibility of such a combination.

In the early stage of electricity supply, separate feeders and even separate generators were used for power and lighting. While in the meantime this practice has been abandoned, it is still usual in large cities at the present day to separate the supply for traction from that for lighting and power, or to provide special power stations and net-works for traction. It must be pointed out that this method, which might be justified with a number of small plants, can only be condemned in the case of large power stations, since, as has been shown in Fig. 1, owing to the inferior utilization, this entails a waste of capital and a permanent disadvantage to consumers.

No disturbances are likely to arise from sudden current rushes caused by traction loads, as these are easily compensated for in large power stations. The statement made by supporters of separated systems that the traction demand is sufficiently heavy to justify a special plant is fundamentally wrong, since they overlook, first, that practically no traction station has yet reached the economical limits as regards size, and secondly, that the point of chief importance is not the reduction of costs for the traction demand, but of those for lighting and power supply.

### Comparison of Works Statistics in Berlin, Chicago and London.

It is now proposed to give a summary of the operating conditions in the Berlin, Chicago, and London plants, thus providing an opportunity for checking the foregoing statements by applying them to practical conditions.

For this purpose the material at disposal has been tabulated in such a manner that the items relating to the three plants can be directly compared with on another. The author has also succeeded, by making some assumptions, in determining the relation between working cost and utility-factor, and has thus obtained the equation for the costs characteristic of all three plants. This conversion appeared to be necessary since the plants in question have a totally different kind of consumption, and therefore work with different util-

TABLE I.—GENERAL DATA.

| No. | Item. | Berlin, 1911-12. | Chicago, 1911 | London, 1910-11. |
|---|---|---|---|---|
| 1 | Company | Berliner Elektricitätswerke | Commonwealth Edison Company | Authorities and companies in and around London |
| 2 | Population, approx. | 2,600,000 | 2,200,000 | 6,500,000 |
| 3 | Power stations:—Number | 6 | 6 | 64 |
| 4 | Installed capacity | 137,000 kilowatts | 221,700 kilowatts | 298,400 kilowatts |
| 5 | Average size | 23,000 kilowatts | 37,000 kilowatts | 4,670 kilowatts |

TABLE II.—CAPITAL.

| No. | Item. | Berlin, 1911-12. | Chicago, 1911 | London, 1910-11 |
|---|---|---|---|---|
| 6 | Assets | $39,000,000 | $68,000,000 | $133,000,000 |
| 7 | Sinking fund, etc. | 7,380,000 | 3,440,000 | 27,200,000 |
| 8 | Real Value | $31,620,000 | $64,560,000 | $105,800,000 |
| | | Cost per kilowatt installed | | |
| | | Per Cent | Per Cent | Per Cent |
| 9 | Power station | 86.50 38 | 116 40 | 161 45 |
| 10 | Distribution System, including meters | 144. 62 | 176 60 | 193 55 |
| | | 230.5 100 | 292 100 | 354 100 |

TABLE III.—WORKING RESULTS.

| No. | Item | Berlin, 1911-12 | Chicago, 1911. | London, 1910-11. |
|---|---|---|---|---|
| | Capacity— | | | |
| 12 | Total peak load, kilowatts | 94,600 | 199,300 | 185,500 |
| 13 | Peak load per power station | 15,800 | 31,700 | 2,900 |
| 14 | Kilowatt-hours generated | 274,000,000 | 684,000,000 | 405,000,000 |
| 15 | Kilowatt-hours purchased | — | 32,000,000 | — |
| 16 | Kilowatt-hours sold | 216,300,000 | 640,000,000 | 319,243,000 |
| | Comprising— | | | |
| 17 | Lighting | 24 per cent | 19 per cent | 61 per cent |
| 18 | Power | 45 per cent | 12 per cent | 27 per cent |
| 19 | Traction | 31 per cent | 69 per cent | 12 per cent |
| | Factors— | | | |
| 20 | Load-factor (at power house) | 33.1 per cent | 41 per cent | 24.9 per cent |
| 21 | Efficiency of transmission system—ratio sold to generated | 0.79 | 0.894 | 0.788 |
| 22 | Reserve factor | 1.450 | 1.11 | 1.61 |
| 23 | Utility-factor (total) | 0.18 | 0.33 | 0.122 |
| | Coal— | | | |
| 24 | Price per ton | $4.25 | $1.95 | $3.11 |
| 25 | Consumption per kilowatt-hour sold, pounds | 3.04 | 3.54 | 5.2 |
| 26 | Overall efficiency of plant, per cent. | 9.7 | 7.6 | 5.0 |
| | Working Costs— | | | |
| 27 | Revenue from kilowatt-hours sold | $8,340,000 | $14,060,000 | $15,160,000 |
| 28 | Expenses | $4,290,000 | $7,020,000 | $6,760,000 |
| 29 | Profit absolute | $4,050,000 | $7,040,000 | $8,400,000 |
| 30 | Percentage of real value | 12.83 | 10.87 | 7.85 |
| | Operating costs per kilowatt-hour sold, in cents— | | | |
| 31 | Selling price | 3.85 | 2.20 | 4.75 |
| | Expenses— | | | |
| 32 | Fuel | 0.581 | *0.278 | 0.742 |
| 33 | Oil, stores, etc. | 0.0095 | 0.011 | 0.064 |
| 34 | Wages | 0.124 | 0.149 | 0.254 |
| 35 | Repairs, maintenance | 0.228 | 0.202 | 0.360 |
| 36 | Rent, taxes, insurance, etc. | 0.0845 | 0.148 | 0.360 |
| 37 | General expenses | 0.204 | 0.203 | 0.339 |
| 38 | Current purchased | ..... | 0.040 | ..... |
| 39 | Municipal participation | 0.746 | 0.066 | ..... |
| 40 | Total expenses | 1.977 | 1.097 | 2.119 |
| 41 | Profit (gross) | 1.87 | 1.10 | 2.63 |

*The conversion to kilowatt-hours sold includes the number of kilowatt-hours purchased therefore the actual value is approximately 4-5 per cent higher.

TABLE IV.—EQUATIONS FOR OPERATIN G COSTS OF EXISTING PLANTS.

$u$ = Utility-factor.

Working Costs including Capital Charges per kilowatt-hour sold, in cents.

| Portion of Plant. | Berlin, 1911-12. | Chicago, 1911. | London, 1910-11. |
|---|---|---|---|
| Power station (exclusive transmission losses)—$K_c$ | $0.154/u+0.391$ | $0.260/u+0.252$ | $0.252/u+0.473$ |
| Transmission system—$K_s$ | $0.1995/u+0.008$ | $0.271/u+0.014$ | $0.270/u+0.0063$ |
| Transmission losses— | | | |
| (a) $V_k$ = kilowatt-hours | $\frac{1}{u}\times 0.028+0.111$ | $\frac{1}{u}\times 0017+0.068$ | $\frac{1}{u}\times 0.022+0.088$ |
| (b) Costs | $V_k \times K_c$ | $V_k \times K_c$ | $V_k \times K_c$ |

ity-factors. Any attempt to draw general conclusions on the advantages of one system over the other is bound to be misleading, unless this is done. Moreover, this analysis seemed to be the only means of obtaining a positive indication of the influence which the difference in centralization of the three plants exercises upon the working and current costs.

The comparative data have been summarized in Tables I to III. The energy consumption per head of population cannot be compared directly from the figures given, since both in London and Berlin the energy is generated in special traction power stations, and in the case of Berlin that generated in block stations must also be included. Unfortunately reliable data in this connection could not be secured; the figures for current consumption in kilowatt-hours per head of population for the years in question may be assumed, however, to be approximately as follows:

| | |
|---|---|
| Chicago ... ... | 310 |
| Berlin ... ... | 170 |
| London ... ... | 110 |

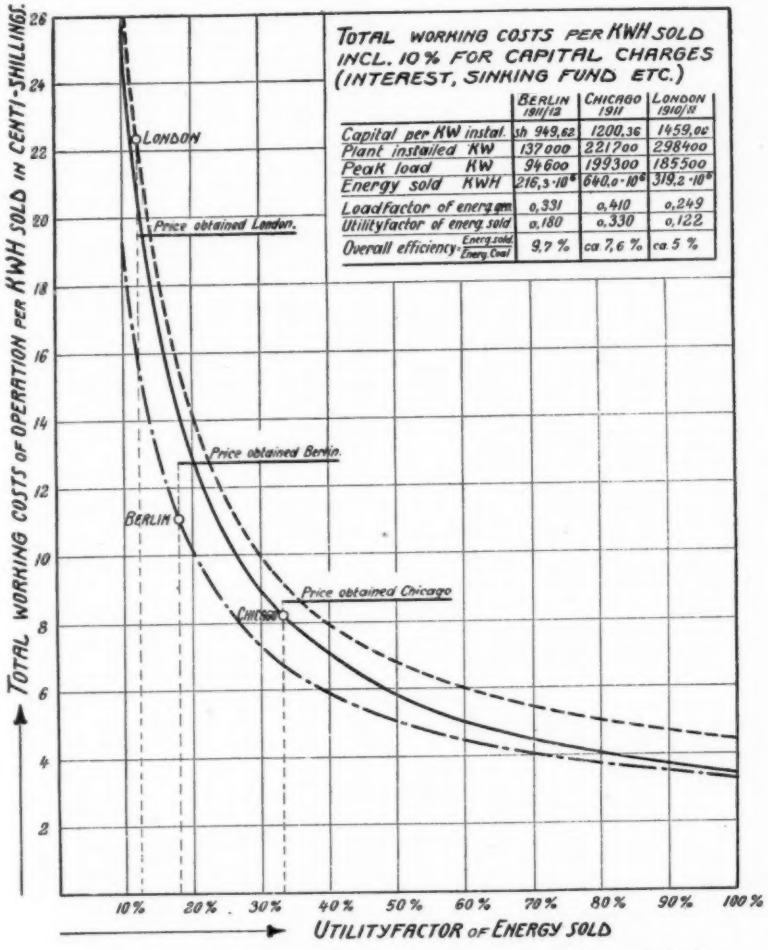
These figures, although somewhat approximate, show that in the two latter cities the consumption should be capable of a considerable rise, even assuming Chicago to have reached the point of saturation, which, in the author's opinion, is not the case.

It is a striking fact that in London the generation of energy is split up among a large number of small stations, whereas Chicago stands pre-eminent as regards centralization.

The proportion of the average peak loads in the different stations is approximately as follows:

| | |
|---|---|
| London ... ... ... | 1 |
| Berlin ... ... ... | 5 |
| Chicago ... ... ... | 10 |

It is noticeable that the costs per kilowatt of the Chicago plants are about 25 per cent higher than those in the Berlin plants, although the former are of nearly double the capacity. This may be attributed to a certain extent to the costs incurred in buying up the competitive companies, the power stations of which have been put out of commission. This sum amounts to about 9 to 10 per cent of the total costs. The explanation of the difference which then remains between the Chicago and Berlin costs may possibly be sought in the different method of design, and in the more expensive living conditions prevailing in the United States. It is impossible, therefore, to draw any conclusions regarding costs per kilowatt.


TOTAL WORKING COSTS PER KWH SOLD INCL. 10% FOR CAPITAL CHARGES (INTEREST, SINKING FUND ETC.)
TOTAL WORKING COSTS OF OPERATION PER KWH SOLD IN CENTI-SHILLINGS.
UTILITY FACTOR OF ENERGY SOLD
LONDON
BERLIN
CHICAGO
Price obtained London.
Price obtained Berlin.
Price obtained Chicago
10% 20% 30% 40% 50% 60% 70% 80% 90% 100%
2 4 6 8 10 12 14 16 18 20 22 24 26

| | Berlin 1911/12 | Chicago 1911 | London 1910/11 |
|---|---|---|---|
| Capital per KW instal. | sh 949,62 | 1200,36 | 1459,02 |
| Plant installed KW | 137000 | 221700 | 298400 |
| Peak load KW | 94600 | 199300 | 185500 |
| Energy sold KWH | $216,3 \cdot 10^6$ | $640,0 \cdot 10^6$ | $319,2 \cdot 10^6$ |
| Loadfactor of energy sold | 0,331 | 0,410 | 0,249 |
| Utilityfactor of energy sold | 0,180 | 0,330 | 0,122 |
| Overall efficiency $\frac{\text{Energy sold}}{\text{Energy Coal}}$ | 9,7 % | ca 7,6 % | ca 5 % |

Fig. 2.—Curves Showing Relation Between Utility-Factor and Cost.

A comparison is, however, possible between Berlin and London, where methods of design and living conditions differ less. From such comparison it will be seen that the total costs per kilowatt installed, with power stations of about 5,000 kilowatts, are approximately 50 per cent greater than for power stations of about 25,000 kilowatts; this difference appears to be still greater, namely 80 to 90 per cent, when the costs of the power stations alone are compared. The proportion of the costs of a power station to that of the network (including meters) is also noteworthy; for Chicago and Berlin it is approximately 40:60, and for London 45:55. It can thus be seen that the cost of the power station decreases as the size of the plant increases.

With regard to the consumption, the three plants can be characterized as follows:

Chicago: traction load predominating (about 70 per cent).

London: lighting load predominating (about 60 per cent).

Berlin: power, lighting, and traction loads in a more even ratio.

London is considerably below the other two cities as regards the utilization of its plant, owing to its predominating lighting load. Fig. 1 shows that in London the load-factor cannot be improved appreciably by centralization; what is necessary is to alter the nature of the consumption.

As reserve factors for power stations are altered with each extension, especially in the case of large units, it is advisable to take the average for a considerable number of years. Thus the figure of 11 per cent for Chicago seems too low, and the figure of 45 per cent for Berlin too high, while for London, where the largest machine unit is about 5,000 kilowatts, the value of 61 per cent should be approximately correct. I consider the load-factor should not largely influence the percentage of reserves. What affects the spares most is the size of the whole plant.

In view of such considerations the following reserve factors ($r$) appear to meet the normal requirements of large cities:

With a maximum load on individual stations of 30,000 kilowatts, $r=1.25$.

With a maximum load on the separate stations of 15,000 kilowatts, $r=1.4$

With a maximum load on the separate stations of 3,000 kilowatts, $r=1.6$.

It is assumed that each power station

is equipped with at least one complete generating set as a stand-by.

Owing to the fact, expressed in equation (5), that the utility-factor depends not only upon the load-factor, but also on the network efficiency and the reserve factor, the utility-factors of the three plants differ to a greater extent than should be expected from the nature of the consumption alone. The ratios are shown in round figures as follows:

London, utility-factor, 12 per cent; load-factor, 25 per cent.

Berlin, utility-factor, 18 per cent; load-factor, 33 per cent.

Chicago, utility-factor, 33 per cent; load-factor, 41 per cent.

These results, together with the remaining items in Tables I and II, enable their dependence upon the utilization to be determined, and by means of the costs characteristic thus found the working conditions can be compared on an equal basis. Fig. 2 shows the total costs characteristic of the plant.

All costs include the capital charges, and in all three cases the normal rate of 10 per cent referred to above has been taken.

The actual utility-factors, Item 23, Table III, are indicated in Fig. 2 by a circle. They therefore represent the "normal price" of the current, i.e., the price at which the works should earn a gross interest of 10 per cent on their capital, neglecting any special sums to be paid to authorities.

The prices indicated in Fig. 2 by a horizontal line represent selling prices actually obtained by the works during the year in question (after deducting special expenses), and therefore permit a direct comparison with the normal value.

**Results of Comparative Calculations.**

From the cost characteristics it will be seen that as regards total costs the Berlin works, notwithstanding their smaller power stations, work more economically than those in Chicago, while the costs of the London works are the least favorable. Nevertheless, the actual energy prices (based on equal utilization for all three plants) are approximately the same. The reason for this is that the selling price in London is about 13 per cent lower and in Berlin about the same percentage higher than the "normal" value.

The relatively high working costs in Chicago, as compared with those in Berlin, are due in my opinion chiefly to the higher costs of the plant (Item 11, Table II) and the higher wages and salaries. Moreover, the Berlin plants show a decided superiority in fuel consumption, although this is counterbalanced by the appreciably higher prices for coal (see Items 24-26, Table III).

The importance of the utility-factor for all three plants will be recognized from the form of the costs characteristic. The curves show that within the values for this factor of 10 to 30 per cent, the selling price can be reduced by more than 3 per cent for each advance of 1 per cent made in utilization, without necessitating extensions or other alterations to the existing plant.

## Independent Telephone Association of America Meets in Chicago.

The first annual convention of the recently organized Independent Telephone Association of America was held in Chicago at the Hotel La Salle on January 6, 7 and 8. The convention was exceptionally well attended, considering the youth of the Association, and evidences were present on all sides that the organization is an energetic one. President E. B. Fisher, of Grand Rapids, Mich., presided at all of the sessions, the first of which was opened shortly after 10 a. m. on Tuesday.

L. D. Mathias, of the corporation counsel's office of the city of Chicago, made an address of welcome, to which D. M. Neill, Red Wing, Minn., responded on behalf of the Association. Mr. Neill strongly urged the need of competition as the salvation of maintained quality of telephone service. He compared the rates in large cities where competition exists in the telephone service to those in cities where there is no competition. Long-distance lines must be placed at the disposal of all on a non-discriminatory basis.

Mr. Fisher's presidential address dwelt at length on the recent revised public and governmental attitude toward trusts and monopolies. He quoted extensively from addresses and writings of Past-President Taft and President Wilson, particularly the latter. The keynote of the present federal administration is competition and freedom of business development. Mr. Fisher also quoted from a memorial of the Inventors' Guild and from engineering papers, showing that monopoly greatly hinders developments of inventions and improved processes. Reviewing the history of competition in the telephone industry, Mr. Fisher said that it was the backbone of the industry until recent years, when a number of independent telephone men became lukewarm in this direction. As the result of this tendency the new association was organized to stand for the old ideals. Referring to commission regulation, he expressed his conviction that state public service commissions can do much good, but the commissioners must be urged to be broadminded and fair. In the telephone industry it has been shown that monopoly never tended to popularization of this service. The idea held in some places that telephone service is a natural monopoly, has no basis and should not be allowed as an exception to the general rule that competition is highly valuable. In closing he referred to the energetic part played by the new association in the investigations made by the United States Department of Justice in the telephone field, which resulted in the now famous letter issued by the Bell interests on December 19, and he claimed that this was a vindication of the organization of the new association.

B. J. Hubbell, Buffalo, N. Y., then referred to the various steps that had been taken in organizing the new association, in which he felt proud that he had taken a prominent part. In the independent telephone field there have arisen many making every effort to keep in the business and many apparently making every effort to sell out and quit the business. The new association was organized to help the former. Recently there have been some of the most important developments in the telephone business, which have culminated as the result of a prolonged campaign. He said there was need of a new organization to crystallize the sentiment of independent telephone men, since the old National Association apparently no longer seemed to do so. The outline of the final agreement submitted by the Bell interests to the Government officials was practically the same as that suggested by the leaders of the new association.

A brief address was made by Mr. Thompson, who said he at first questioned the wisdom of dividing independent telephone interests into two groups. Although he was convinced of the value of the new association, he suggested that negotiations be entered into with the old National Independent Telephone Association to join with the new organization.

On Tuesday afternoon the session was opened with an address by J. B. Middleton, of Portland, Ore., who submitted a communication from Samuel Hill, president of the independent company of that city. He then spoke of the telephone developments in the Northwest and of the long fight which culminated in the suit brought against the American Telephone & Telegraph Company, in Portland. He then showed many fine views of Portland and vicinity.

W. A. Alexander, of Chicago, made an address on "Liability Insurance and Workmen's Compensation Acts." He pointed out the difference between liability insurance and what is now going to be known as workmen's compensation. The former was based on the old common law and involved the several defenses of contributory negligence, etc., that were of great value to the employer in suits brought by employees. Compensation acts, on the contrary, provide for immediate medical aid and subsequent compensation, usually up to a limiting term of eight years, and some-

times even for life pensions for disability. Such compensation acts are in force in 19 states and legislation thereon is pending in several others. Within a year probably the majority of the states will have such acts in force, although in most of the states where these laws have been enacted employers have the option of coming under their jurisdiction or remaining under the old rules. They usually are penalized for choosing the latter course. These compensation acts do not apply to injuries to the general public, but only to employees. Although telephone companies may have the impression that they are quite free from accidents to their employees, he cited figures of many cases showing that they are by no means immune.

Charles E. Merriam, alderman in the city of Chicago, made an address entitled "The City's Relation to Public Service Corporations." He referred to the growth of public sentiment toward utility companies and pointed out that one of the evils connected with utility service heretofore has been the pernicious political activity of the utilities. This has been the bane of public life. Such activity must cease, for the welfare of both public and the utility. He strongly urged legal control of local utilities. The relation of the public to the utility are invariably improved by driving out the promoter and so-called financier and replacing him by local investors. In rate regulation the basis must be a fair return on the actual investment; the public will not stand for fictitious values. He thought that much money has been spent in clever publicity to apparently deceive the public as to the quality of service rendered. He thought that every municipality should have reserved the legal and financial power to take over utilities within its boundaries. He compared foreign cities in this regard with the hampered conditions prevailing in nearly all American cities. In conclusion he said that American utilities are passing through a period of probation in which they must decide either to submit to stringent regulation or to public ownership and operation.

The session on Wednesday morning was opened by an address by C. B. Randall, St. Paul, Minn., who talked on "Independent Telephony—What Shall It Be?" He explained in detail the origin of the new association, which was formed originally a year ago as the United Independent Telephone Association of America by a group of independent men who felt convinced that the old association was no longer alive to the important problems before the independent telephone industry. There never have been so many matters of importance to this industry presented at one time. He narrated the various stages of the federal investigation of the telephone business, in which private independent men took an active part, due to the failure of the old National Association to take the initiative. Many telephone men hesitated to support the independent forces before efforts were renewed to reform the old association. Since the latter had failed, however, the scope of the new association was enlarged last fall and it was fully organized, so as to extend over the entire country. It now has membership from most of the states. The new association has taken a most active part in presenting the case of the independent interests before the government officials. It must continue to take such an active part in further investigations that are doubtless to be made. He attacked the attempt at monopoly of telephone manufacture by one large company and strongly urged the need of retaining an aggressive association to stand for the best interests of the independent movement.

J. C. Crowley, Superior, Wis., described the plan developed by the service department of the Association for issuing bulletins, whose aim will be particularly to reach the smaller companies so as to improve their service and help them achieve economies. Through personal investigation he has found that through lack of proper maintenance the life of telephone equipment in the small towns is very short. This it is hoped to remedy by aid from the service department. President Fisher emphasized the need of co-operation to help the smaller companies both in improving their service and in making proper reports to commissions.

John W. Coffey, Indianapolis, Ind., presented an illustrated paper describing an account system which he said was simple, flexible, practical, and meets the requirements of state and national commissions.

## New York Automobile Show.

At the fourteenth annual Automobile Show, which opened at the Grand Central Palace, New York City, on Saturday, January 3, there were in position 352 exhibits of gasoline and electric cars. Only six different makes of electric cars were exhibited and 78 different makes of gasoline cars were on view. Electric starters and gear-shifting devices and incandescent lighting systems were seen in increasing numbers, electrical accessories of this nature now forming part of the standard equipment of many of even the moderate-priced gasoline cars.

A cable dispatch from Paris states that a pocket-style wireless receiver has been developed which has a receiving-zone radius of 30 or more miles.

## CHOOSING THE LAMP AUXILIARY.

By H. C. Meredith.[1]

In a great many cases, efficiency alone is taken as a basis in choosing a reflector for a particular installation. As a matter of fact, whether a glass or metal reflector is being considered, there are several things of more importance than its absorption.

A lighting system should be installed which will give the desired intensity of illumination with the highest degree of uniformity for the least expenditure of energy. Assuming that the distribution curves of units which are being considered are such that these units will give uniform illumination when properly placed, the factors upon which the merits of the reflectors depend from the standpoint of efficiency are the percentage of total lamp flux in the zone from zero to 60 degrees, the percentage of the total lamp flux in the zone from 120 to 180 degrees and the amount of light between these two zones, with particular attention to that light in the zone from 60 to 90 degrees. (Light vertically downward is designated as in the zero-degree direction, and vertically upward as at 180 degrees; other directions are designated in degrees from 0 to 180).

That one reflector has a higher efficiency than another, as shown by a photometric test, is due in many cases to the first showing a greater amount of light about the 90-degree position or in the upper hemisphere. The light which is in the zero to 60-degree zone falls upon the plane of illumination and is directly useful. Of that light which is in the zone from 120 to 180 degrees, a large amount is absorbed, but the remainder reaches the plane of usefulness. The percentage of this light upward which reaches the plane of usefulness is dependent upon the color of the ceiling; the whiter the ceiling, of course, the more light will be reflected and diffused downward. The amount of light in the zone between 60 degrees and 120 degrees should be as small as possible, since it must be reflected many times before it can reach the plane where it is useful. There should, however, be sufficient light to avoid a dull appearance of this part of the reflector, or a gloomy effect upon the wall.

Glare is attributed to polished surfaces, and if the inside of the reflector is a polished surface, that light from the zone between 60 and 90 degrees is the most harmful; the light flux in this zone should therefore be small. Uneasiness of the eyes and injurious effects often result from placing reflectors with highly polished surfaces within the range of vision.

1 National Lamp Works of General Electric Company.

None of the factors mentioned affecting the choice of lamp auxiliary should be neglected, but the two 60-degree zones from zero to 60 degrees and 120 to 180 degrees are of the greatest importance, and of these, the zone from zero to 60 degrees should receive first consideration. The object in each case is to determine the energy cost for each candlepower in these zones. If the reflectors compare well in this respect, the efficiency should next be considered, especially if the reflectors are made of glass, as a higher efficiency will indicate that the total light is greater. Another thing which should be taken into consideration in determining a reflector for a certain installation is its appearance, especially where illuminating glassware is to be used. Wherever possible, the glassware should harmonize with the architectural features and finish of the interior.

In considering the case of street-lighting balls, care should be taken to use glassware through which neither the filament nor the light source can be seen. The ball should be one which diffuses the light sufficiently well to cause it to appear as the light source itself. It does not always follow that the ball giving the best diffusion will have the highest absorption, for there are very poor street-lighting balls which absorb as much light as good ones. Sufficient light of a diffused character, properly distributed, gives excellent and satisfactory illumination.

## The Problem of Electric Ore-Smelting in Norway.

While electric iron-ore smelting is making decided headway in Sweden, where some of the largest and best managed concerns in the iron industry are adopting the process on a large scale, the new departure did not prove a success at the first serious attempt in Norway—that at the Hardanger Electric Iron & Steel Works. The unsatisfactory working there of a process which it was hoped would prove of marked advantage towards the exploitation of the country's iron-ore deposits, has been very fully gone into by experts, the causes have been laid bare, as far as possible, and fresh experiments now point to the drawbacks being overcome.

The matter was the subject of a very interesting discussion in the Polytechnical Society in Christiania, several leading experts being present and giving their opinions and experience. Gustaf Odquist went fully into the causes of the Hardanger failure, and agreed with the electrometallurgical committee that the unsatisfactory result was the outcome of several co-operating circumstances, but disagreed with the committee as to the type of furnace adopted not contributing its part to the failure. The type in question was not, in his opinion, suitable for coke as a means of reduction. Besides, the ore used was too poor, and a displacement of phases reduced the calculated efficiency of the first furnace by one-third; several things also pointed to the fact that electrodes of too large a diameter had been used at Hardanger. It was difficult to exploit the available power economically, there having been too large variations in the current. It thus proved necessary to have at disposal 800 kilowatts more than the average. The numerous stoppages in the working had also a most unfavorable effect, both technically and financially. The experiences at Hardanger had shown that electric iron-ore smelting, with coke as means of reduction, could very well be worked, but it would not prove financially advantageous with the system used at Hardanger. The iron produced there was from $3.25 to $3.75 more costly per ton than the iron which had been produced in Sweden with charcoal as means of reduction, although charcoal was considerably more expensive than coke. The problem was to find a cheaper agent for reduction than charcoal, and a furnace where coal or coke could be used with advantage.

Captain Thome, a member of the electrometallurgical committee, on the whole endorsed the report of the committee, but stated that a new and more exhaustive report would be forthcoming in the course of the winter. Two other members of the committee, who were prevented from being present at the meeting, had, he stated, found that the electric pig iron produced at Hardanger from very poor and rather impure ores, exceeded their expectations as regarded its quality.

Dr. Lindermann stated that Professor Farup had recently undertaken a series of laboratory experiments, the results of which would soon be made known. These results showed that, if electric iron-ore smelting were resumed at Hardanger, it would have to be worked on different lines, and then good financial results could be brought about. It had been demonstrated by these experiments that is would be an easy matter to produce, with coke, iron which, in quality, could fully vie with the Swedish.

General Olesen gave some interesting information about the ore smelting at Tinnfos, which, among other things, proved that very good results could be obtained also from the poor ores. At Tinnfos they are now going to adopt the electric production of steel by conveying the pig iron direct from the blast furnace to the steel furnace. German experiments had shown that this could be done with advantage.—*Engineering*

## BOOK REVIEW.

"Government Ownership of Railways." By Samuel O. Dunn. New York: D. Appleton & Company. Cloth, 400 pages (5x7½ inches). Supplied by the Electrical Review Publishing Company for $1.50.

The question of the nationalization of the American railways is discussed from various points of view, the cost of capital, efficiency of management, economies of consolidation, adequacy and quality of service, safety, rates and their adjustment, and the effects upon labor and upon political conditions. As would be expected of the editor of *The Railway Age Gazette*, the author favors the present system of private ownership, but he presents both sides of the question with fairness. That freight rates are more important than passenger rates is emphasized. The author frankly and ably defends the "what-the-traffic-will-bear" principle in the determination of rates, and shows that the whole tendency of private ownership is toward this principle, while government ownership tends toward the distance principle in determining rates. He seems to consider the best solution of the railway problem to be a progressive and active but broad-guage policy of governmental regulation.

Competition, both among railroads and in the commercial world generally, is given more weight than it is given by most present-day writers on economic subjects. One would expect a chapter devoted to the much discussed questions of the present extreme concentration of control, of interlocking directorates, and of whether under present conditions directors do, as is widely believed, sometimes play the double role of buyers and sellers in purchase of branch lines, real estate, etc. The author dismisses the matter very briefly with the statement that these were the shortcomings of the past, but this will hardly satisfy the public mind after reading current discussions of such cases as the Frisco and the New Haven.

The book contains a great store of information both statistical and of general interest of the railways of all the leading and many of the minor countries of the world. Whether the reader believes in private or in government ownership, he will find the book both profitable and interesting reading. P. G. Agnew.

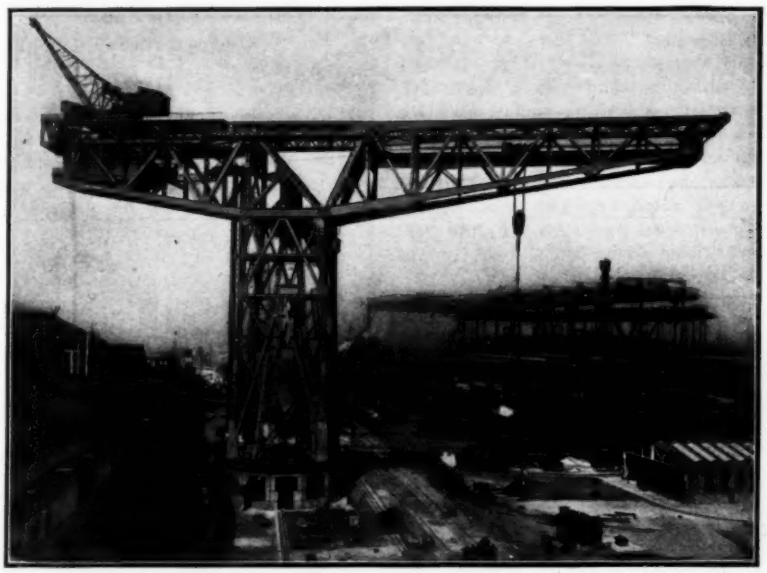
## Lessons From the Ohio Flood.

At a meeting of the Western Society of Engineers to be held in the Monadnock Block, Chicago, on the evening of January 19, John W. Alvord will present a paper entitled "The Engineering Lessons From the Ohio Floods."

# New Electrical and Mechanical Appliances

## Hamburg 250-Ton Electric Revolving Wharf Crane.

The 250-ton electric revolving wharf crane seen in the accompanying illustration was installed at the fitting-out berth in the Blohm & Voss shipyard in Hamburg, Germany, and was erected primarily for handling the heavy machinery and materials that entered into the construction of the great steamship *Vaterland*. This crane was built by the Deutsche Maschinenfabrik and is a new design of hammer type crane, having a movable jib that can be raised to nearly a vertical position. It was chosen on account of the great dimensions of modern ships and the correspondingly great height of the masts.



Gigantic Electric Shipyard Crane.

It is stated by the designers of the crane that while the largest ships now in existence can pass underneath the jib in its horizontal position, it is expected that the luffing motion will be needed in the future. When it is necessary to raise the jib, the main trolley is locked to the end of the boom, raised with same, and performs the same function as the top sheave of an ordinary jib crane.

This great crane has the top of the runway rail 200 feet above water level. The maximum load of 250 tons can be lifted at a radial distance of 113 feet from the center of the crane and the capacity decreases with increasing out-reaches and is 110 tons at the maximum out-reach of 174 feet. The lifting speeds of the large crane are fully 26 feet per minute for loads up to 50 tons, 13 feet per minute for loads from 50 to 100 tons, 6.5 feet per minute for loads from 100 to 200 tons, and 5 feet per minute for loads over 200 tons. The crane can make a full revolution in about 12 minutes and the jib can be raised to its highest position in 30 minutes.

Besides the main trolley, which runs inside of the jib girders, a revolving traveling jib crane of 20 tons capacity at 33-foot radius is provided. The auxiliary jib crane lifts loads up to 16 tons at a speed of 65 feet per minute. The traveling speed is 160 feet per minute, a full revolution can be made in about two minutes and the raising of the jib requires about three minutes.

By means of the small crane it is possible to pick up loads up to 10 tons at a distance of 240 feet from the center of the crane and deposit them 164 feet back of the center of the crane without revolving the main structure, covering a total distance of over 400 feet. The area covered by the crane is 180,000 square feet, or more than four acres and the arrangement of the traveling jib crane on top of the main structure is an innovation that considerably increases the efficiency of the giant crane, as it permits of the transportation of small loads at high speed and makes it easy to handle masts and other parts of a ship located at an elevation.

The Leonard system of electric control is utilized and the motors together have a capacity of 550 horsepower. It is stated that only one man is needed to operate the large crane, and his cabin is located directly under the hinge of the big jib. When the small crane is working, the operator takes his place in the cabin arranged in front of the small jib, where he controls all the motions of the jib crane and also the revolving motion of the main structure. The two spindles that are employed for raising the jib are 19 inches in diameter and 65 feet long. This great electric crane shows the latest and most up-to-date practice in electric revolving wharf-crane construction.

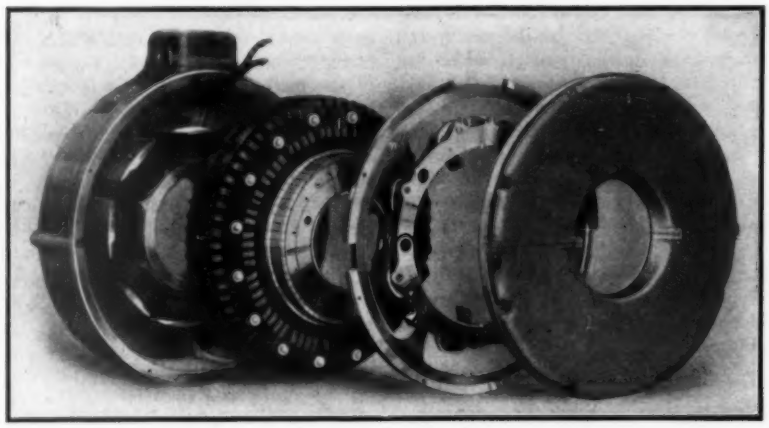
## New Inherent-Regulation Feature of 1914 U-S-L Electric Starter and Lighter.

The United States Light & Heating Company, Niagara Falls, N. Y., has developed a new type of the U-S-L electric starter and lighter for 1914 which employs a novel method for controlling the generator output at varying engine speeds. This method, termed inherent regulation, is unique and distinctive both in principle and results accomplished. All external regulating devices, such as carbon piles and other resistances commonly used for the purpose, have been eliminated, the regulation being secured by means of a new generator design with special disposition of the copper wire coils, which are anchored in a fixed position in the machine.

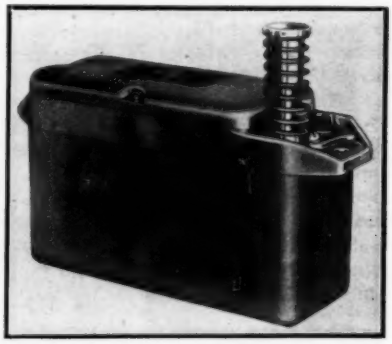
Inherent regulation, as used in the U-S-L system, is the result of concentrated effort on the part of the company's engineers to develop a method of generator control that would not only be an improvement over existing methods, but would in addition do away with adjustments and external regulator mechanism and thereby preclude any possibility of injurious tinkering by

inexperienced persons. Tests, conducted both in the company's laboratories and on the road over a long period of time, have conclusively proven the merit of the U-S-L inherent-regulation principle and equipment. Among the advantages claimed for the system are: first, increased generator efficiency, since there is no necessity for dissipating an excess of energy through the regulating system; second, exceptionally low cutting-in speed, or speed at which the generator commences to charge the battery; third, entirely automatic action; fourth, absolute elimination of adjustments and opportunity for tampering.

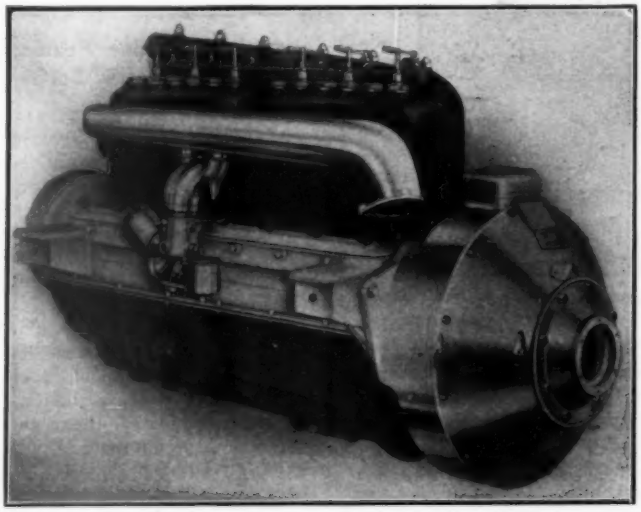
haps more correctly the dynamotor, is a combination motor for starting and a generator for charging and lighting in one machine. It has three main parts, the field, armature and brush rig. The armature is of flywheel size and weight and is bolted to the flange of the engine crankshaft in place of the cast-iron flywheel. This armature, which is the only moving part in the U-S-L system, is built in a special size for each particular make of car and has precisely the same inertia characteristics as the original cast-iron flywheel which it displaces. The armature has a large radius and surrounds the field poles. The fields and brush rig are stationary at all times. When the starting button is pressed, current flows from the battery through the armature and fields, causing the armature to revolve at 200 to 400 revolutions per minute. Since the armature is connected directly to the crankshaft, there is no need for objectionable power-transmitting devices such as gears or chains. The engine necessarily spins at the same rate of speed as the flywheel armature. The motor-generator is nothing more than a flywheel with electrical functions added. The design simply takes advantage of mass and space already provided. The inert mass of the cast-iron flywheel is so utilized that instead of one kind of work the flywheel on the U-S-L-equipped car does three kinds of work. There are no bearings to oil, nothing to be damaged by back-firing, no excess weight is added to the car; and no off-center load is thrown on the chassis. The pull of the starter is absolutely uniform, extending completely around the circumference of the armature. This distributes the stresses and equalizes the pressure on the bearings. Any of the operating switches may be closed at the wrong time accidentally, but no damage can be done.



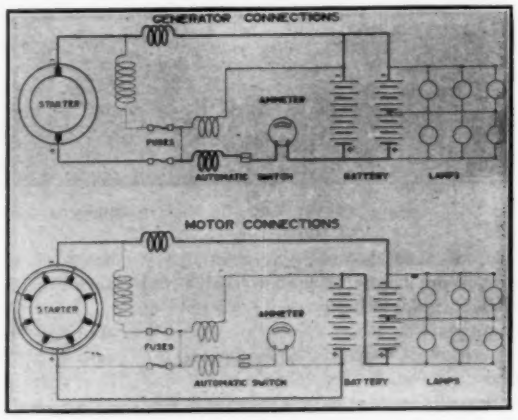
Motor-Generator Disassembled.



Starting Switch.



U-S-L Starter and Lighter on Sheffield-Simplex Engine.




Connection Diagram of Starter and Lighter.

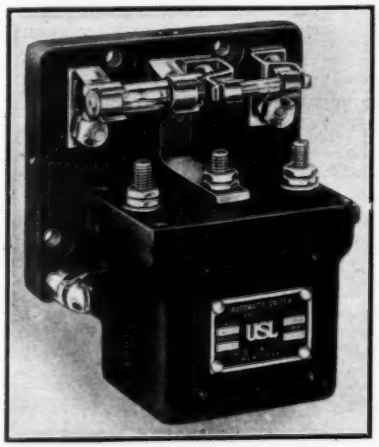
Aside from the regulating feature, the U-S-L equipment remains practically the same as before. It consists essentially of four units, the motor-generator, a starting switch, the storage battery, and a small automatic switch which opens and closes the battery-charging circuit.

The U-S-L motor-generator, or per-

The U-S-L electric starter and lighter is distinctive not alone because of unique design, but also because of the effective manner in which it performs its function. As a starter it will spin, at a speed of over 200 revolutions per minute, a six-cylinder engine, 4-25-inch bore by 6-inch stroke, requiring an initial pull of 170 pounds on a 12-inch crank. It is designed in a range of

sizes from a 60-foot-pound starter for a small four-cylinder engine to a 400-foot-pound starter that spins a certain motor fire-pump engine having eight cylinders, 6 by 6 inches, at a speed above 200 revolutions per minute. These speeds are maintained even in the coldest weather and promote efficient carbureting and ignition. Automobile engineers agree that high starting speeds, 200 revolutions per minute and over, are essential for cold-weather starting with the low grade of fuel now being used. The starting speed of the U-S-L equipment is ample for the most adverse conditions, and the generator has ample capacity for even the slowest driver, and the fastest driver cannot overcharge his battery.

The makers of the U-S-L system claim an energy consumption, measured in watt-minutes per engine revolution, that is surprisingly low. A large six-




U-S-L Automatic Switch.

cylinder engine having a 5.125-inch stroke is spun by the equipment at 340 revolutions per minute with an energy consumption of 5.5 watt-minutes per revolution; a typical four-cylinder engine of five-inch stroke, spinning at 280 revolutions per minute, consumes 5.25 watt-minutes per revolution; another four-cylinder engine of 4.5-inch stroke, requiring a torque of approximately 70 foot-pounds to start, is spun at 350 revolutions per minute with 3.15 watt-minutes per revolution used.

After the foot-button has been pressed down and the engine commences to fire, the button is released and the motor-generator is automatically converted from a starting motor to a charging and lighting generator driven by the engine. At a definite engine speed the automatic switch closes and permits current to flow from the generator into the battery. In a test conducted under city driving conditions, a U-S-L-equipped car was stopped and started every two blocks. Forty starts were made per hour over a period of six hours. An average speed of ten miles per hour was maintained. The generator, therefore, had sufficient capacity to replace in the one and one-half minutes available after each start for charging, the energy just taken from the battery in starting. The outfit has been developed to meet all the peculiar requirements of automobile operation. It can be designed to furnish any amount of current at any speed.

The decided angle at which the brushes ride on the commutator tends to make them hug the commutator surface and also prevents chattering. The brushes will wear on an average of one-thirty-second-inch per 1,000 miles and with at least one inch of wearing length, it is calculated that they will last 32,000 miles of driving. The aluminum housing, which extends over the brush rig, effectually protects the motor-generator and has the same appearance as the housing for the flywheel and clutch of a unit power plant.

The storage battery used with the outfit is of U-S-L manufacture and is especially designed for starting and lighting duty. The cells are contained in a hardwood case and are firmly imbedded in a high-melting-point sealing compound. This construction effectually insulates all the cells and prevents vibration and breakage. All brass and copper connections are incased in a heavy layer of lead to prevent corrosion. The special and mechanically strong plates and the heavy connectors and terminals render the battery capable of giving a heavy momentary discharge with a minimum loss in voltage.

The starting switch is installed beneath the floor-board of the car with the push-button protruding within easy reach of the driver's foot. It is of the revolving drum type and has contacts similar to those used in street-car controllers. The contacts break in a bath of oil. The switch has two positions, starting and charging. When the foot-button is pressed down as far as it will go, starting connections are made. When the foot-button is released, charging connections are made.

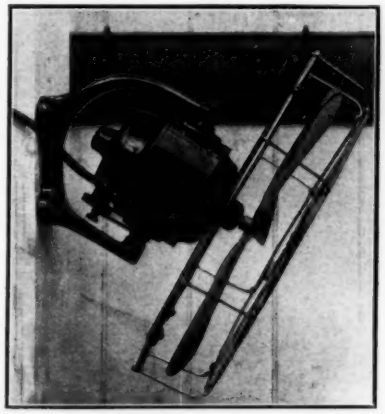
The automatic switch is simply a small magnetically operated carbon-break switch which closes the charging circuit when the generator voltage is sufficient for charging, and opens when the generator voltage falls below that of the battery. The small fuses, attached to this unit, are a protection against damage to the apparatus due to tampering.

Extensive deposits of platinum susceptible of easy exploitation have been discovered in Westphalia, Germany.

## Ball-Bearing Bracket Oscillating Fan.

The wall type oscillating fan illustrated herewith was originally designed for textile mills manufacturing cotton fabrics, the idea being to impart an even distribution of moisture-laden air to the fabrics. For this use the fan body is entirely inclosed and moisture-proof.

Owing to the demand for a fixed wall oscillator for general commercial use the original design of the fan was slightly changed to meet conditions. The outfit consists of a cast-iron bracket inclined at a fixed angle of 25 degrees, equipped with ball bearings allowing the fan body to oscillate with a minimum of friction. The oscillating mechanism is entirely concealed within the rear end cover leaving visible nothing but the revolving disk and lever. By twisting a knurled head in the disk the arc of oscillation may be varied in three steps from 90 degrees to zero,



New Diehl Oscillating Fan.

at which point the fan stops oscillating. To take up the forward thrust the fore part of the shaft is supported by a ball bearing. The body casing and end covers are of pressed metal and the motor frame is composed of laminations adding materially to the efficiency of the fan.

A speed regulation giving three running speeds has been designed for use with this fan, but is furnished only on special order and at an additional price. The Diehl Manufacturing Company, of Elizabeth, N. J., is the manufacturer of this fan.

## Stock Given to Employees.

In recognition of faithful and efficient service the board of directors of the Monongahela Valley Traction Company voted to set aside $25,000 of the company's preferred stock for distribution among its employees. About 350 men will benefit by this generous gift from the company.

## Blonck Recording Boiler-Efficiency Meter.

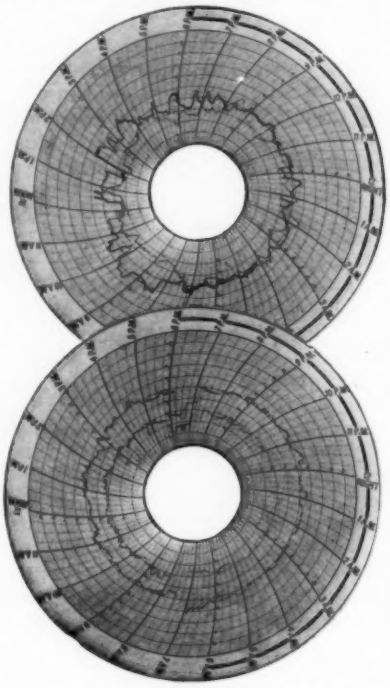
In the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN of October 12, 1912, and February 15, 1913, there appeared a description and a discussion of the results of using an indicating type of boiler-efficiency meter developed by W. A. Blonck & Company, Fisher Building, Chicago. This firm has now placed on the market a recording type of meter embodying the same ideas as in the former type and intended to be used in connection with it. As in the indicating meter, the new recording meter shows the draft resistance of the fuel bed and the drop in draft between furnace and damper. Both these records are made on the same chart, one of them being registered in red and the other in blue ink. The recording meters are installed in the office or some convenient place where the chief engineer or superintendent of the plant may have ready access to them; the indicating meters are installed at the boiler fronts for the immediate guidance of the firemen.

The general appearance of the new meter is shown in the accompanying illustration. It is connected by means of two tubes to the boiler furnace in the same manner as the indicating type of meter. The new meter differs from the latter in that, instead of using liquids to show the draft, there are provided two very sensitive copper bellows, each of which is connected to one

Recording Boiler-Efficiency Meter.

of the recording styluses. The instrument is hermetically sealed.

The charts shown in the second illustration show the operating conditions of a boiler furnace before and after Blonck meters were applied thereto and their use explained to the fireman. The boiler from which this record was obtained is a 500-horsepower horizontal water-tube boiler provided with a traveling chain grate. The total available draft was slightly over 0.8 inch water gauge and an investigation



Records of Boiler Performance Before and After Firing in Accord with Boiler-Efficiency Meter.

showed that for highest efficiency under normal conditions of load the draft through the fuel bed should be 0.3 inch and that through the boiler 0.5 inch. The upper of the two charts shows the record before the fireman was instructed. It will be observed that the draft distribution was irregular, extreme variation occurring at short intervals. The draft through the fuel bed varied from a maximum of 0.5 inch at about 2 a. m., to a minimum of 0.18 inch at 2 p. m. Without changing the damper position a decrease in the draft through the fuel bed resulted in the admission of excess air and resultant fuel waste. Since excess air means greater volume of gases flowing through the boiler for each unit of time and therefore an increase in the draft between furnace and damper, this causes the peculiar converging and diverging of the record lines in the chart. During the brief periods shown on the upper chart when the lines run practically parallel (as at 9 a. m.) the draft conditions remain uniform. When the record shows a decrease in both the draft through the fuel bed and that through the boiler this indicates a decrease in the rate of combustion and also a decrease in steam output, but no change in efficiency. When an increase in both furnace and boiler draft is shown this indicates an increase in the rate of steaming without change in efficiency.

A striking contrast is noticed in the lower of the two charts which records the draft conditions after the fireman began to operate the furnace in accordance with the indication of the Blonck boiler-efficiency meter. It shows that the efficiency can be maintained very closely and the value of such a record is in giving the chief engineer or superintendent of the plant a check on the performance of each furnace.

## New Motor Attachment Plug.

The extensive and increasing use of portable and small motor-driven devices, such as vacuum cleaners, grinders, floor polishers, compressors, etc., has created a demand for a separable type of motor attachment plug that can be permanently secured to the motor frame. The new motor plug recently designed by the Cutler-Hammer Manufacturing Company, of Milwaukee, Wis., which is shown in the accompanying illustration, is made for this purpose. The base can be permanently secured to the motor frame and this carries the rugged double lugs which are like those used on the caps of the standard line of C-H attachment plugs. These contacts are dead when the device is not in use, while the live contacts of the part attached to the flexible cord are sunk in below the surface.

Rugged heat-resisting Thermoplax, having proven eminently adapted for plugs, is used in the construction of this

Cutler-Hammer Motor Attachment Plug.

plug which has the high rating of 10 amperes, 250 volts. The design of the heavy double lugs and contacts permits of separating the plug by a pull at any angle, a feature which is considered of considerable advantage in separable attachment devices. This plug has been approved by the Underwriters' Laboratories.

# Latest Approved Fittings

**The electrical fittings illustrated and described in this department have been approved by the Underwriters' Laboratories, Incorporated, following examination and tests conducted under standards of the National Electrical Code as recommended by the National Fire Protection Association.**

**ATTACHMENT PLUGS, Fuseless.—H. T. Paiste Company,** Philadelphia, Pa.

Edison-base type, 660 watts, 250 volts, catalog No. 400.

Approved December 6, 1913.

**BRAKE SOLENOIDS—The Cutler-Hammer Manufacturing Company,** Milwaukee, Wis.

Solenoids for operating mechanical brakes.

Bulletin Nos. 7710, 7720, 9865.

Approved December 6, 1913.

**CABINETS. — Metropolitan Engineering Company,** 1238 Atlantic Avenue, Brooklyn, N. Y.

Steel cabinets, catalog Nos. 2-Std., 953 and 954, with sheet-metal meter adapters for inclosing the connections to meters, also four-inch to ten-inch sheet-metal connectors.

Must be installed with the surfaces beneath the meter adapters covered with sheet metal at least one-sixteenth inch thick.

Approved December 6, 1913.

**CUTOUT BASES, Cartridge Fuse.—The Trumbull Electric Manufacturing Company,** Plainville, Conn.

Porcelain Base:

250 volts, 0-30 amperes, catalog Nos. 19,353, 21,353, 21,653, 21,993, 25,693, 25,873, 29,653, 80,423.

250 volts, 31-60 amperes, catalog Nos. 19,356, 21,356, 21,656, 21,996, 25,696, 25,876, 29,656, 80,426.

600 volts, 0-30 amperes, catalog No. 25,694.

600 volts, 31-60 amperes, catalog No. 25,697.

Slate Base:

250 volts, all capacities, catalog Nos. 8,000-05, inclusive, 8,010-15 inclusive, 8,019, 8,021-25 inclusive, 8,030-35 inclusive.

600 volts, all capacities, catalog Nos. 8,050-54 inclusive, 8,060-64 inclusive, 8,070-74 inclusive, 8,080-84 inclusive.

Approved December 6, 1913.

**CUTOUT BASES, Link Fuse.—Metropolitan Engineering Company,** 1238 Atlantic Avenue, Brooklyn, N. Y.

Meter-testing cutout bases for repulsion fuses:

Catalog No. 189, 31-60 amperes, 250 volts, for use in cabinet 953.

Catalog No. 190, 61-100 amperes, 250 volts, for use in cabinet 954.

Approved December 6, 1913.

**FIXTURES.—Illuminating Engineering Company,** 17 Washington Avenue, Detroit, Mich.

Fixtures shown by tests and examinations conducted by Underwriters' Laboratories to be in accordance with requirements of the National Board of Fire Underwriters and examined at factories and passed by Underwriters' Laboratories, have labels attached.

Approved December 10, 1913.

**FUSES, Open Link.—Metropolitan Engineering Company,** 1238 Atlantic Avenue, Brooklyn, N. Y.

Repulsion-type fuses, 60 and 100 amperes, 250 volts, for use in cutout bases 189 and 190.

Approved December 6, 1913.

**HEATERS, Electric.—General Electric Company,** Schenectady, N. Y.

"G. E." heaters, 95-250 volts.

Industrial heating devices:

Glue pots, types 1-1, 1-2 1-4, 1-6, 1-15 to 1-18 inclusive, and 1-31; 20 to 1,100 watts.

Air heaters and luminous radiators:

Tubular air heaters, types A-6 to A-17 inclusive, 1,200 to 5,000 watts.

Luminous radiators, types A-4, A-23 and A-24; 500 to 2,000 watts.

Individual contact plug, catalog No. 78 839, for use with "G.E." heaters.

Approved December 10, 1913.

**PHOTO PRINTING MACHINE.—Stadler Photographing Company,** 1322 Wabash Avenue, Chicago, Ill.

"Webster Photo Printer." Five 250-watt tungsten lamps.

This device consists of a sheet-metal box, in which are installed receptacles for lamps, provided with a glass plate at the top and a rolling felt pad to cover negatives and paper placed on the glass. When the felt pad is pulled over the glass the lamps are automatically lighted for a predetermined time and extinguished by a falling weight and escapement mechanism which opens a switch.

Approved December 17, 1913.

**RECEPTACLES, For Attachment Plugs.—The Bryant Electric Company,** Bridgeport, Conn.

Bryant Flush Receptacles:

"Junior" 6 amperes, 250 volts, 12 amperes, 125 volts, catalog Nos. 393, 394, 411, 1,508, 1,509; with plugs, catalog Nos. 375 or 1,510.

Edison type, 660 watts, 250 volts, catalog No. 1,708.

"Chapman" 12 amperes, 250 volts, catalog Nos. 1,108, 1,363, with fuseless attachment plug, catalog Nos. 397 and 1,110.

Disappearing door type, 10 amperes, 250 volts, catalog No. 430; plate for same, catalog No. 431; plug for same, catalog No. 432.

Chapman-to-Edison adapter, 660 watts, 250 volts, catalog No. 472.

Approved December 13, 1913.

**RHEOSTATS.—The Cutler-Hammer Manufacturing Company,** Milwaukee, Wis.

Pressure-controlled speed regulators.

These devices each consist of a pressure regulator, direct-connected to the contact arm of a speed regulator. Bulletin Nos. 3,310, 9,370.

Not approved for use in connection with automatic sprinkler or similar fire protective equipments, for which service their merits have not been investigated.

Approved December 8, 1913.

**SOCKETS, Weatherproof.—The Bryant Electric Company,** Bridgeport, Conn.

"Bryant" 660 watts, 250 volts.

Porcelain shell, catalog No. 9,496.

Approved December 19, 1913.

**SWITCHES, Automatic.—Fort Wayne Electric Works of General Electric Company,** Fort Wayne, Ind.

Pressure switches:

10 amperes, 250 volts, 20 amperes, 125 volts, catalog Nos. 99,817, 99,818, 99,819, 190,381, 190,382.

Not approved for use in connection with automatic sprinkler or similar protective equipments, for which services their merits have not been investigated.

Approved December 16, 1913.

**SWITCHES, Automatic.—The Cutler-Hammer Manufacturing Company,** Milwaukee, Wis.

Elevator control and safety devices:

Elevator-car switches, bulletin Nos. 7,730, 7,790, 7,791.

Limit switches, bulletin Nos. 7,740, 7,741, 7,750, 7,751, 7,752, 7,760, 7,770, 7,771, 7,772.

Slack-cable switches, bulletin No. 7,780, 7,781, 7,782.

Elevator door switch, bulletin No. 7,800.

Push-button switches, bulletin Nos. 7,810, 7,815, 7,820, 7,835.

Belt switch, bulletin No. 7,825.

Quick-make-and-break double-pole switch, bulletin No. 7,830.

Reverse switches, bulletin Nos. 9,850, 9,855.

Floor stop device, bulletin No. 7,805.

Approved December 6, 1913.

**SWITCHES, Automatic.—The Cutler-Hammer Manufacturing Company,** Milwaukee, Wis.

Pressure regulators (making and breaking pilot circuit), bulletin No. 6,761.

Not approved for use in connection with automatic sprinklers or similar fire protective equipments, for which services their merits have not been investigated.

Approved December 8, 1913.

# Current Electrical News

## LIGHTING AND POWER.

*(Special Correspondence.)*

PORTLAND, ORE.—The Portland Railway, Light & Power Company will install 200 arc lamps. O.

SHERIDAN, MONT.—The Chamber of Commerce has started a movement for ornamental lighting. C.

SPRINGFIELD, S. D.—$10,000 will be expended for a municipal lighting plant. Address the city clerk.

ELLSWORTH, ILL. — Wartena Brothers are interested in a project to establish an electric lighting system here. Z.

RIVERSIDE, CAL.—The Council will extend the street lighting system a distance of one mile. Address the city clerk.

IRONTON, MINN.—The Village Board is reported to be contemplating the construction of a municipal electric light plant. Z.

WYNDMERE, N. D.—The question of establishing municipal lighting is being considered. Address the city clerk for particulars.

WINONA, MINN.—An agitation has been started for a "White Way" lighting system on the business streets. George Hirson is interested. C.

ROCK FALLS, ILL.—Citizens here have approved a proposition to issue bonds for the improvement of the municipal electric light plant. Z.

GLYNDON, MINN.—Glyndon Light & Power Company has been incorporated by A. J. Fitzsimmons, L. M. Lowe and others. The capital is $5,000. C.

MONMOUTH, ILL.—Stockholders of the Monmouth Public Service Company have ratified plans for improvements to cost about $100,000. Z.

BELTRAMI, MINN.—This village is considering securing electric current for lighting from the new power dam now being erected near Crookston. C.

DALLAS, TEX.—The Texas Power & Light Company will soon commence the construction of a plant at Waco. Address J. F. Strickland, president.

HAZELTON, N. D.—A co-operative company is to be formed here for the purpose of installing an electric light plant. Address the city clerk.

PITTSBURG, TENN.—The Pittsburg Power Company has been incorporated with $15,000 capital stock by A. Rex Flinn, L. D. Gasteiger and others.

SPOKANE, WASH.—Commissioner Fassett has been instructed to secure estimates for installing a separate plant for the generation of electrical energy for light and power at the municipal building.

ELLENDALE, N. D.—J. L. Tucker, representing the St. Paul Electric Company, met with the Council in regard to establishing an electric light plant in this city. C.

BEVERLY, MASS.—This city is about to make extension in its street lighting system. The board of aldermen has appropriated $580 for the purpose.

MT. OLIVET, KY.—This city is considering the construction and equipment of an electric lighting plant. The estimated cost of the proposed plant is $5,000. G.

CLEVELAND, O.—The Otis Steel Company has secured a permit to construct a power plant as part of a group of new buildings. Equipment soon will be purchased. R.

AURORA, ILL.—The Dayton & Ottawa Power & Light Company has been incorporated with a capital stock of $100,000 by Fred W. Simpson, Dewitt E. Northam and others.

WINCHESTER, KY.—This city is considering the establishment of an electric light plant for the operation of an ornamental lighting system which was recently installed. G.

VINE GROVE, KY.—The Citizens' Lighting Company has been organized with $3,000 capital stock to operate a going plant. W. E. Crutcher is the principal stockholder. G.

DALLAS, TEX.—Bowie Light & Power Company has been incorporated with a capital stock of $50,000. The incorporators are Hiram Grosman, Mose Grosman and W. C. Woodlief.

MARION, S. D.—Marion Light & Power Company has been incorporated with a capital stock of $25,000 by J. A. Heeren, John Groepel, M. H. Dains and S. H. Dains, of this place.

McCLUSKY, N. D.—McClusky has an opportunity to secure an electric-light plant by furnishing a site and granting a franchise to Philip Kiefer, of Moorhead, Minn., who has made this offer.

CHATTANOOGA, TENN. — The Chattanooga Armature Works is to build a new plant and will need a considerable amount of additional equipment. Motor-driven traveling cranes will be installed. G.

CHICAGO, ILL.—Consumers Power & Light Company has been incorporated with a capital stock of $100,000 to manufacture electricity for power. The incorporators are Charles Kiper, Jerome N. Frank and Harvey R. Willard.

EUGENE, ORE.—George S. Edmonton, engineer for the Oregon Electric Company, has completed a preliminary survey for the development of 45,000 horsepower within the next five years at Clear Lake, 75 miles from here.

WARSAW, N. Y.—The Warsaw Gas & Electric Company has arranged with the village to take all its poles off Main Street in the business section and substitute cables in under ground conduits along the edge of the sidewalk.

MELVIN, ILL.—The Village Board has granted a franchise to the Central Illinois Utilities Company to operate an electrical distributing system in Melvin. The company will be given a contract to light the village streets. Z.

NEPONSET, ILL.—The Village Board has granted the Kewanee Light & Power Company, of Kewanee, a 25-year franchise to sell light and power in the village. A transmission line to Sheffield will supply the power here. Z.

SAN DIEGO, CAL.—The United Light, Fuel & Power Company has filed an amended application with the Railroad Commission asking authority to issue $188,000 of stock, part of the proceeds to be used for extending its system.

HARRISBURG, PA.—The Ludlow Electric Light Company has been chartered with a capital stock of $5,000 to supply electric light, heat and power to Hamilton Township. The incorporators are Homer Shoemaker, George F. Barntt, and others.

BEND, WASH.—The Washington Water Power Company, of Spokane, has purchased the plant of the Big Bend Light & Power Company, including its interests in this section. It is the intention of the purchasing company to improve the service. O.

PRIEST RIVER, IDAHO.—L. V. Smith and a party of engineers have been looking over the power sites belonging to the Pan Handle Railway Company. As soon as the situation warrants, a modern power plant will be built on Priest River to supply nearby towns with electric current.

INDEPENDENCE, MO.—This city is holding bids for a new engine for the municipal lighting plant, pending the settlement of a proposition by a cold storage company. The latter has offered the city of Independence current at such a rate that the city will be able to retail it profitably, it is said. M.

NAVASOTA, TEX.—The Navasota Light & Power Company has increased its capital stock from $20,000 to $200,000 and changed its name to the Navasota Ice, Light, Power and Water Company. Extensive improvements and additions will be made to its light and power and waterworks plants. D.

WAUSAU, WIS.—The first application for permission to build a power dam under a new law enacted by the last legislature has been made by C. M. and J. M. Arnquist, of this city. They will build a 400-foot dam in the Apple River near the village of St. Frairie and erect an electrical plant and sell current to other towns. C.

WAKEFIELD, MICH.—The Gogebic & Iron Counties Railway and Light Company has obtained a five-year franchise from the village of Wakefield to furnish it with electricity. The electric company will do the building to the pumping station and the village the wiring in the town. Address Charles Smeed, consulting engineer, for particulars.

SPRINGFIELD, MASS.—Plans for the improvement of the street lighting

system are under way, and it is proposed to make radical changes after May 1, when the present lighting contracts expire. The city board of supervisors will inspect various efficient lighting systems to the end that the most approved system may be adopted for Springfield.

HONESDALE, PA.—A first mortgage has been recorded by the Pennsylvania, New York & New Jersey Power Company in the sum of $25,000,000. Upon the strength of this certain improvements being carried on will be completed. The company is at present engaged in building several dams along the Paupack for the purpose of generating power. N.

TUCSON, ARIZ.—The Arizona Power & Water Company has been organized as a subsidiary company of the Cababi Mining Company, which operates mines in southwestern Pimo county, with a capitalization of $5,000,000. The purpose of the organization is to utilize waters that flow down the Cababi Canyon in the Rincon Mountains for the generation of electrical energy.

SHARON, PA.—Advices are that President Stevens of the Mahoning & Shenango Railway & Light Company, a subsidiary of the Republic Railway & Light Company, has announced that the former company will spend about $300,000 in improvements and extensions to properties the coming year. The principal part of the expenditures will be for enlarging the equipment in the central generating station at Lowellville, O., which was placed in operation a year ago.

WINCHESTER, ILL.—An electric light company has been formed by R. W. Frost, E. J. Frost, Ed D. Smith, Albert Hainsfurther, G. A. Clark, W. D. Gibbs, C. W. Banes, James T. Wilson and R. M. Riggs. The City Council has granted a 25-year franchise to the company on the condition that work upon the construction of a plant must begin within three months and the plant must be ready for service within nine months. It is planned to issue stock to every consumer of electricity. Z.

BILLINGS, MONT.—Surveys for an electric railway from a point about two and one-half miles west of Custer to the mouth of the Big Horn Canyon have been completed under the supervision of A. W. F. Koch for the Big Horn Canyon Irrigation & Power Company. The line will be 68 miles long. In addition to supplying electric power for the railroad which will connect with the Northern Pacific at Custer, Hardin and other towns along the Big Horn will be furnished with electric lighting. Surveys will be started in March by B. Lillis of Billings.

ATLANTA, GA.—The Southern Ferro Concrete Company, Engineers and Contractors, Atlanta, Ga., have been awarded the general contract for the erection and completion of the Columbus Hotel, Columbus, Ga., including the reinforced concrete skeleton frame, elevators, plumbing, heating, electrical work, fixtures, refrigeration plant, kitchen equipment, etc. The building will be ten stories high, and will cost $200,000. Those interested in furnishing sub-bids should address Southern Ferro Concrete Company, Trust Company of Georgia Building, Atlanta, Ga.

LOS ANGELES, CAL.—Attorneys and engineers representing this city recently appeared before the State Board of Water Power Control with plans to develop a municipal power project in Mono County, involving an expenditure of $10,000,000. One of the most pretentious features of the proposed undertaking is a tunnel 26 miles long to carry water from streams tributary to Mono Lake into the Owens River Valley, where it will be merged with the Los Angeles aqueduct project. In view of the proposed project, opposition was entered to the application of E. G. Ryan for permits to appropriate waters from Rush Creek and other Mono county streams in the vicinity of Mono Lake.

VALDOSTA, GA.—A proposition to develop the water power on the Withlacoochee River near this city, which has been discussed for several years, bids fair now to be pushed to a successful end. Preliminary surveys of the stream, beginning at a point three miles northwest of Valdosta, are being made by A. F. Langford, a well known civil engineer, for parties in South Carolina, who are interested in the development. The surveys indicate a powerful fall in the river near where the Valdosta, Moultrie & Western railroad bridge crosses, and it is believed that enough power can be developed there to turn every wheel in this and neighboring towns. Mr. Langford will be prepared in a short while to make a comprehensive report, which will decide the question of development.

## TELEPHONE AND TELEGRAPH.

*(Special Correspondence.)*

SILVIS, ILL.—The Village Board has granted the Tri-City Automatic Home Telephone Company permission to establish an exchange in Silvis. F

MARIETTA, O.—The Washington Telephone Company has been incorporated with a capital stock of $300,000 by G. L. Lund, F. L. Alexander, and others.

BLYTHE, CAL.—S. D. Kamar has applied for a certificate of public convenience and necessity to construct a telephone system in the section surrounding this town.

LAMBERTVILLE, N. J.—The Bell Telephone Company will make extensions in its system to Sergeantsville and vicinity, and will also build new lines in other sections of Hunterdon County. A.

ROCK ISLAND, ILL.—City Electrician Vincent Murphy has announced that he has about completed the plans for the new $10,000 police-alarm system which is to be installed early next spring.

MARIETTA, O.—The Washington Telephone Company has been incorporated with a capital stock of $300,000 by F. L. Alexander, B. L. Bullman, G. J. Lund, H. H. Miller and W. S. Plummer.

BRYANT, IND.—People's Telephone Company has been incorporated with a capital stock of $8,000 to operate a telephone exchange. The directors are W. H. Elberson, James Rupel and Peter L. Treece.

MOWEAQUA, ILL.—The Moweaqua Telephone Company has been incorporated with a capital stock of $20,000 to operate and maintain telephone lines. The incorporators are P. L. Drew, S. S. Clapper and R. E. Clapper. Z.

WENATCHEE, WASH.—George A. Pitcher and others have filed a petition with the commissioners of Chelan County, asking for a franchise to construct a telephone and telegraph line along certain roads of the county.

WILSALL, MONT.—A stock company has purchased the local telephone system from the Bell Company, and a switchboard will be installed here and also a telephone exchange. A copper toll-circuit will be built at Livingston.

FISHER, ILL.—The newly incorporated Fisher Telephone Company will install a new switchboard and build a system in the village. Charles Fairfield, I. J. Knupp, Chris. Summers, Isaac Hiser and G. C. Williams are the directors. Z.

SPRINGFIELD, MASS.—The New England Telephone & Telegraph Company is planning an addition to its building on Worthington street and Henry S. Hyde, vice-president of the company, said that the addition would be built during the coming year.

DEMING, N. M.—The Mountain States Telephone Company is rapidly extending its telephone system in Southwestern New Mexico, having just completed a line between Deming and Rincon. Work will be started soon on a line from Deming to Columbus. D.

COLUMBUS, O.—The State Public Utilities Commission has authorized the Central District Telephone Company, a subsidiary company to the Bell system, with lines between Steubenville and Youngstown, to issue $2,000,000 capital stock. About $400,000 of the proceeds from the sale will be spent on improvements in Ohio.

LEXINGTON, MO.—E. D. Graham, a former mayor of Mexico and owner of the telephone plant at Lexington, announces that he intends to build a new telephone exchange here. Work on the new plant will begin at once. Mr. Graham says he will install the latest type, multiple common battery, selective switchboard.

NEW ORLEANS, LA.—The Cumberland Telephone & Telegraph Company is making preparations for an extensive increase in business that will follow the establishment of new firms and agencies upon the completion and operation of the Panama Canal. The company will expend nearly $2,000,000 on its New Orleans plant in the next three years.

ALLENTOWN, PA.—Reorganization of the Consolidated Telephone Companies has been effected by Colonel Harry C. Trexler, of Allentown; Alvan Markle, of Hazleton; W. B. Given, of New York, formerly of Columbia, Pa.; Murray Gibson, of Philadelphia, and John Graham, of Newville. Two million dollars has been raised for a general rehabilitation of the system.

SAN ANTONIO, TEX.—The Austin Road Telephone Company has been organized by the residents of the Austin and Terrell roads east of San Antonio to build a rural telephone line in that section. The company will run its lines a distance of ten miles and will extend a mile north of Fratt. The officers are P. J. Reininger, president; Gus Neuse, secretary, and C. W. Ackerman, treasurer.

SAN FRANCISCO, CAL.—Announcement has just been made that the Pacific Telephone & Telegraph Company has approved estimates amounting to $453,850 for the construction of a toll line across California and Nevada, to be made part of a transcontinental line. The new line is to extend from this city to Calvada on the California-Nevada boundary line and thence to Wendover, Nev., near the Nevada-Utah boundary line, where it will connect with the Mountain States Telephone & Telegraph Company.

## ELECTRIC RAILWAYS.

*(Special Correspondence.)*

VISALIA, CAL.—The Big Four Electric Railway Company has been granted a 50-year franchise in this city.

NELSONVILLE, O.—James Sharp, postmaster, is promoting an electric line from Lancaster to Nelsonville.

OSWEGO, ORE.—The City Council has granted a franchise to the Portland, Eugene & Eastern Railway for its electric wires and trains. Electrifying West Side lines of the Southern Pacific will now be rushed.

CHICAGO, ILL.—The Evanston Railway Company filed for record an open mortgage, under which it will issue bonds for the rehabilitation of its lines and to provide money for other corporate purposes.

MORRISTOWN, N. J.—The Morris County Traction Company, of New Jersey, is contemplating the erection of a power plant at that place to cost about $250,000. Address O. G. Schultz, Morristown, N. J.

IDAHO FALLS, IDAHO.—The citizens of this place have taken up with the Public Utilities Commission the question of granting the application for construction of a street railway and power plant in this city.

NEW ORLEANS, LA.—It is rumored that the New Orleans, Southern & Grand Isle Railroad is to be fitted up as an electric line, and a big hotel, an ideal summer and winter resort erected at Bay Adam.

NASHVILLE, TENN.—The Nashville Railway & Light Company has changed its charter so as to be allowed to construct lines on a large number of streets where it has not operated heretofore. Percy Warner is president. G.

NEW BERN, N. C.—This city is soon to have a new car line, one which will go out to the Eastern Carolina Fair grounds and to Glenburnie Park, the city's newest pleasure resort, and which will be opened up during the summer months.

COLUMBIA, S. C.—The Northwestern Electric Railway Company has been incorporated in South Carolina. The company proposes to build an electric railway from Easley, S. C., to Augusta, Ga. The company proposes to do a general passenger and freight business.

WILMINGTON, DEL.—Goldsboro Street Railway Company has been incorporated with a capital stock of $50,000 to purchase, acquire, construct and operate railways, street cars, etc. The incorporators are Herbert E. Latter, W. J. Mahoney, Oscar J. Reichard, all of Wilmington, Del.

PITTSBURGH, PA.—A state charter has been granted to the Western Traction Company to operate lines in Allegheny, Fayette and Washington Counties. The capital is $5,000 and the incorporators are B. C. Hovis, Crafton; F. J. Taylor, Munhall; W. H. Lardner, Wilkinsburg; W. B. Curry and A. L. Davies, Pittsburgh. S.

SEATTLE, WASH.—Construction of 38.4 miles of double track or 84.25 miles of single track as an addition to the municipal street car line now consisting of a line four miles long to Salmon Bat, at a cost of $1,218,220, with $787,000 added for equipment, making a total of $2,005,220, is the plan of Councilman Oliver T. Erickson.

HARRISBURG, PA.—The Beaver Valley & Ohio Railway Company has been granted a charter to build a line from a point in Beaver County to the Ohio state line. The road will be 12 miles long and is capitalized at $120,000. The incorporators are W. A. Goehring, M. G. Hibbs, W. A. Goehring, Jr., F. R. Latshaw and F. B. Hall. R.

CLOUDCROFT, N. M.—The Cloudcroft Commercial Club has reopened negotiations with a party of Illinois and Kansas City capitalists for the construction of an interurban line from this place to Hope and Artesia. The proposed line will be about 90 miles long and will pass through a wonderful scenic region. Scott Williams is secretary of the Commercial Club. D.

GALESBURG, ILL.—The Peoria, Galesburg & Western Railroad Company has filed with the recorder of Knox County a mortgage for $1,500,000 in favor of the Fort Dearborn Trust and Savings Bank of Chicago to secure a bond issue of like amount for the acquisition of franchises and the construction of an interurban railway from Peoria to Galesburg. Z.

TAYLORVILLE, ILL.—The Springfield, Rochester & Hillsboro Railroad Company has filed articles of incorporation. The company, which has a capital stock of $100,000, will build an interurban railway from Springfield to Hillsboro, with a branch through Rochester to Taylorville. The incorporators are Frank M. McGowan, Nathaniel J. Hamilton, A. Barker, M. D. Barker and Jesse H. Thomas, all of Springfield. Z.

LANCASTER, O.—Plans for building an electric railroad from Lancaster to Nelsonville, a distance of 33 miles, and thereby linking Athens and the Hocking valley district with Columbus by traction lines, may be realized if a company composed of Hocking Valley citizens succeeds in leasing the old canal property between the two cities from the state. James M. Dollison, of Lancaster, and James Sharp, postmaster of Nelsonville, are chief promoters of the enterprise.

AUGUSTA, ME.—Construction of the 100-mile electric railroad through Aroostook County forest wilderness from Washburn westward, for which permission to build has just been granted by the Railroad Commissioners of Maine, is of great importance to Maine, not only because it is part of a great transcontinental system, and will create new business in that way, but also because, via the Bangor & Aroostook Railroad, it will furnish an all-rail outlet for the richest lumber tract in New England, will transport supplies and products to and from a region that is fabulously rich in water-power and fertile farm lands. The road will pass almost wholly through a wilderness. After leaving Washburn, it passes through Wade and Portage Lake, and does not strike another settlement until it reaches the Province of Quebec.

## PROPOSALS.

SWITCHBOARDS.—Sealed proposals will be received by the War Department, Office of the Chief Signal Officer, Washington, D. C., until January 10, for furnishing five switchboards, power and distributing frames for fire-control switchboard room, under proposal No. 687.

FLAME-ARC LAMPS.—Bids will be received until January 15 for furnishing flame-arc lamps at the office of the Sanitary District, Room 700 Michigan Avenue, Chicago, Ill. The flame-arc lamps for which tenders are invited are series alternating-current inclosed flame and arc lamps. Address John McMillen, clerk.

ELECTRIC LIGHT AND POWER SYSTEM.—Sealed bids will be received by the Town Council of Farnhamville, Iowa, until January 19, for furnishing material and constructing an electric light and power system. Work must commence on said improvement on or before March 1 and be completed on or before June 1. Plans are on file in the office of J. W. Hartinger, clerk, Farnhamville.

SIGNAL CABLE AND CABLE END BELLS.—Sealed proposals will be received at the office of the General Purchasing Officers, Isthmian Canal Commission, Washington, D. C., until January 21 for furnishing signal cable and cable end bells, as per Canal Circular 818. Blanks and general information may be obtained from any of the Assistant Purchasing Officers, who are located in all of the large cities of the United States.

MISCELLANEOUS ELECTRICAL APPARATUS.—Sealed proposals will be received at the office of the General Purchasing Officer, Isthmian Canal Commission, Washington, D. C., until January 13 for furnishing electric cable, conduit and fittings, electric detonators and miscellaneous electrical apparatus, as per Canal Circular 817. Blanks and general information may be obtained from any of the Assistant Purchasing Officers, who are located in all of the large cities of the United States.

ELECTRICAL CABLE.—Proposals in duplicate will be received by the trustees for the Water Works and Improvement bonds of the City of Jacksonville until January 15, for furnishing and delivering in good order f. o. b. cars Jacksonville, Fla., certain items of lead-covered underground electrical cables in accordance with plans and specifications on file in the office of the Chief of the Fire Department, Jacksonville. Each bid must be accompanied by a certified check payable to Frank Richardson, Chairman, without endorsement or condition of any kind, in the sum of $500 as a guarantee that the bidder will, if awarded the contract, promptly enter into an agreement for furnishing the cable and furnish a surety bond in the sum of $1,000 acceptable to the Board. Bids must be addressed to the Chairman of the Board and be marked "Bid for Underground Cables for Fire Alarm."

MISCELLANEOUS ELECTRICAL APPARATUS.—Sealed proposals will be received by the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until January 20 for furnishing one 25-kilowatt turbo-driven generator, to be delivered at the Navy Yard, Portsmouth, N. H., as per Schedule 6223; eight electric air heaters for ships and 1,600 feet of single-conductor navy standard armored wire, both to be delivered at the Navy Yard, Brooklyn, N. Y., as per Schedule 6222; miscellaneous spares for electric ranges, to be delivered at the Navy Yard, Brooklyn, N. Y., as per Schedule 6221, renewing storage batteries for motor trucks, Navy Yard, Boston, Mass., as per Schedule 6204; until January 27 for 600 pounds of electrolyte acid in carboys, to be delivered at the Navy Yard, Mare Island, Cal., as per Schedule 6201; until February 3 for one electric spot light as per Schedule 6193; and until February 10 for two five-kilowatt radio sets for ship installation, as per Schedule 6196, to be delivered at the Navy Yard, Brooklyn, N. Y.

## NEW INCORPORATIONS.

BANGS, TEX.—Bangs Fuel & Light Company has been incorporated with a capital stock of $10,000 by James W. Wayman, Charles Hart and R. F. Hart.

GREEN BAY, WIS.—Minahan Electric Company has been incorporated with a capital stock of $5,000 by John E. Minahan, Eben R. Minahan and Victor I. Minahan.

CINCINNATI, O.—The Gem Electric Company has been incorporated with a capital stock of $1,000 by A. L. Wolf, T. L. Bratten, C. Spengel, A. St. C. Bevis and George E. Bailey.

MINNEAPOLIS, MINN.—Edwards Electric Company has been incorporated with a capitalization of $10,000 by J. O. Edwards, C. P. Edwards and Fred Dexter, all of this city.

SAN FRANCISCO, CAL.—Articles of incorporation have been filed here for the Reliable Electric Company with a capital stock of $50,000, by A. E. Cerf, J. B. Shlare and Bernard Zellensky.

PHILADELPHIA, PA.—The Electrical Development & Machine Company has been incorporated with a capital stock of $20,000. S. C. Seymour, of Camden, N. J., is named as the principal owner.

GREENVILLE, S. C.—Victor Motor Car Company has been incorporated with a capital stock of $100,000 to manufacture automobiles and will build an electrically operated plant to have an annual capacity of 2,000.

LOS ANGELES, CAL.—Olston Electric Stove Company has been incorporated with a capital stock of $200,000. The directors are W. L. Rosa, C. E. Stoner, M. B. Lewis, G. J. Rowley and J. Gardner.

ALBANY, N. Y.—Elgas Fixture Company, Incorporated, has been granted articles of incorporation, capitalized at $1,500. The incorporators are Edward A. Conroy, Hugh J. Collins and John J. Cregan, of Albany, N. Y.

LOS ANGELES, CAL.—Articles of incorporation have been filed here for the Magnetic Trolley Retriever Company, with a capital stock of $500,000, by J. W. Kays, F. L. Gilman, Louis J. Hembree, Fred L. Dorman and Verna T. Dorman.

CHICAGO, ILL.—The Klingelsmith Electric Truck Company has been incorporated with a capital stock of $350,000 to do an electric-vehicle business. The incorporators are Joseph M. Klingelsmith, Michael F. Cure and Earle F. Tilley. Z.

SKOWHEGAN, ME.—The Skowhegan Electric Company has been organized and the certificate of organization filed. The object of the company is to acquire and hold real estate and to lease and sell and generate electric current. The capital stock is $200,000 and the officers are Herbert L. Swett, president; F. W. Briggs, secretary and treasurer.

DAWSON SPRINGS, KY.—The Dawson Light & Power Company has been organized and will take over the electric light plant heretofore operated by the Dawson Milling Company. E. A. Stevens, head of the milling company, will be manager of the lighting company, the new company being incorporated because of a growth in the business to an extent which has made separation of the two enterprises desirable. It is planned to increase the capacity to 100 kilowatts and to manufacture alternating instead of direct current. G.

## FINANCIAL NOTES.

Westinghouse Electric has during the last four weeks felt a decided slump in new orders booked. Strangely enough orders held up right through November, the sales for that month being only $150,000 less than incoming business in October, a difference of under five per cent. But December sales will record a material decline and this slump may likely enough last over into 1914, although the Westinghouse management is not nearly so pessimistic as some other corporation leaders and feels that the depression will be of comparatively short duration. However, the Westinghouse people have no cause for anxiety, says the *Wall Street Journal*. The fiscal year ends March 31 and in the eight months to November 30 we understand that net profits after payment of all interest charges were $3,140,000. The company's dividend requirements for full twelve months amount to 7 per cent on the small issue of $4,000,000 preferred, or $280,000, and 4 per cent on the $35,194,837 common stock, or say, approximately, $1,408,000. The total of these two dividend requirements for a year is, therefore, $1,688,000, against which the company has already earned net of $3,140,000, or $1,452,000 more than the dividends for the full year to March 31 next. In other words, the company is on easy street so far as net for the current fiscal period is concerned. Even if December and the ensuing three months produce no net whatever, the dividend can be continued and nearly $1,500,000 turned back into plant or used for additional working capital. In eight months the company earned a balance of eight per cent for the common stock, or at the rate of 12 per cent per annum. It is unreasonable to expect that for the full year the earnings for the junior issue will go below 10 per cent. As business has fallen away in last month, the company has reduced its working forces at East Pittsburgh works. Already a cut of between 2,500 and 3,000 has been made and more help will have to go if business continues to decline or does not rally. As is usual, however, with declining business, the cash balance is growing and the company is in the most comfortable financial position of its long career.

The National Gas, Electric Light & Power Company, which was organized in 1904, has increased its authorized capital stock from $2,000,000 common and $2,000,000 six-per-cent preferred to $5,000,000 common and $5,000,000 preferred, respectively. The company controls a number of gas and electric light and power properties and is now said to be considering the acquisition of additional properties.

The Martinsburg (W. Va.) Power Company has filed a mortgage to secure $5,000,000 of bonds with the Safe Deposit & Trust Company, of Baltimore, as trustee. The bonds will be issued from time to time as required by the corporation. The company plans an enlargement of its central generating station to be in position to furnish current for the new electric railway at Martinsburg, and also for other corporations.

Stone & Webster are offering $250,000 of the six per cent preferred stock of the Keokuk Electric Company which has been organized under the laws of Illinois. The company does the electric light, street railway, power and gas business in Keokuk, serving a population of 20,000. Stone & Webster are also offering in blocks of 10 shares, seven preferred and three common, $750,000 of preferred and $225,000 of the common stock of the Central Mississippi Valley Electric Properties at $900 a block.

The largest trust deed ever filed for record in Saline County Ill., was filed in the recorder's office by the Southern Illinois & St. Louis Railway Company. The document amount involved is $2,500,000. The deed is made in favor of the Fort Dearborn Trust & Savings Bank of Chicago, as trustee, and it relates to the Western extension of the Southern Illinois Railway & Power Company, which will be constructed from Harrisburg, Ill., to Marion, Herrin, Johnston City, West Frankfort and Benton.

According to official estimates, gross earnings for 1913 of the Edison Electric Illuminating Company of Brooklyn and Kings County Electric Light & Power Company, the holding organization, will amount to over $5,600,000, an increase of nearly $500,000 over 1912. On December 1, the 55th consecutive quarterly dividend was paid, which for ten years has been at the rate of eight per cent per annum. On January 1, total stock outstanding was $12,942,900, against $10,000,000 a year ago.

Of the $458,000 three-year five-per-cent convertible notes of the United Railways & Electric Company, of Baltimore, outstanding, but about $50,000 additional was converted previous to the expiration of the conversion privilege, leaving about $400,000 which will be retired in cash on maturity July 15, 1914. Originally there were $3,125,000 of these notes outstanding, but the amount has been reduced to approximately $400,000 through conversion at par for the notes and 25 for the common stock of the company, which is $55 a share par value.

The Dayton Power & Light Company has been authorized by the Ohio Public Utilities Commission to issue $125,000 five-per-cent bonds and $50,000 six-per-cent preferred stock to purchase the Wilmington Water & Light Company. This is one of a number of companies not distant from Dayton which the Dayton Power & Light Company is anxious to acquire. The Dayton company has a generating plant in Dayton of sufficient capacity to supply the smaller towns bordering that city.

The Public Utility Commission of New Jersey has granted permission to the Public Service Electric Company to issue $3,000,000 of its capital stock at par, the proceeds to be used for extension and improvements. The original application was for $4,000,000. The Public Service Corporation has filed a certificate with the Secretary of State showing that it has issued $2,000,000 five-per-cent general-mortgage, sinking-fund gold bonds.

The Brooks & Company interests, of Scranton, Pa., which also control the United Service Company, have completed arrangements for the consolidation of the Twin Cities Traction Company, the Midland Power & Traction Company, the Coshocton Light & Heat Company, the Newcomerstown Electric Heat & Power Company, and the Lafayette Light & Power Company under the name of the Ohio Service Company. Application has been made to the Ohio Public Utilities Commission for approval of the consolidation. The consideration to be paid for the properties is given as $923,631 and the property value as $941,248. It is understood that the new company will work in close connection with the United Service Company.

Reorganization of the official staff of the Reading Transit & Light Company, a subsidiary of the Eastern Power & Light Company, has been completed and the

new officers of the Reading Transit Company and its constituent corporations are now in charge. W. S. Barstow, who has been president, has been succeeded by Norman McD. Crawford, formerly president of the Mahoning & Shenango Railway & Light Company. J. B. Taylor and F. V. Henshaw are vice-presidents. W. S. Barstow remains as president of the Metropolitan Electric Company with Mr. Crawford as vice-president and general manager. Mr. Barstow and Mr. Crawford hold similar positions with Neversink Mountain Railway and the Oley Valley Railway, two of the subsidiaries of the Reading Company.

### Dividends.

Bay State Street Railway; semi-annual of $3 on the first-preferred stock, payable February 2 to stock of record January 17.

Bell Telephone Company of Pennsylvania; the regular quarterly dividend of 1.5 per cent, payable January 15, to stock of record January 5.

Cincinnati, Newport & Covington Light & Traction Company; a quarterly dividend of 1.125 per cent on the preferred stock, and a quarterly dividend of 1.5 per cent on the common stock, payable January 15 to stock of record of December 31.

Electric Light & Power Company of Abington and Rockland; the usual semi-annual dividend of $4 a share on its capital stock, payable January 1 to stock of record of December 29.

Edison Company of Boston; the regular quarterly dividend of $3, payable February 2, to stock of record January 15.

Metropolitan West Side Elevated Railway Company; regular quarterly of 1.25 per cent on the preferred and 1.20 per cent on the common stock, both payable December 30 to stock of record December 27.

Metropolitan South Side Elevated Railway Company; regular quarterly of 1.75 per cent, payable December 30 to stock of record December 27.

Pennsylvania Lighting Company; the regular quarterly dividend of 1.25 per cent on the preferred stock, payable January 15, to stock of record January 3.

Public Service Company of Northern Illinois; quarterly of $1.25 on the common stock, payable February 2 to stock of record January 19.

Stark Electric Company; quarterly dividend of 0.75 per cent, payable January 1 to stock of record December 26.

Standard Underground Cable Company; regular quarterly dividend of three per cent, and an extra dividend of three per cent, payable January 10 to stock of record January 5.

### Report of Earnings.

AMERICAN LIGHT & TRACTION.

| | 1913 | 1912 |
|---|---|---|
| November gross | $ 424,945 | 404,581 |
| Net after expenses | 414,323 | 395,143 |
| 11 months gross | 3,954,604 | 3,775,329 |
| Net after expenses | 3,841,309 | 3,667,722 |

MONTANA POWER COMPANY.
(Including Great Falls Power Co.)

| | 1913 | 1912 |
|---|---|---|
| Nine months gross | $2,564,907 | $2,147,922 |
| Net after taxes | 1,778,243 | 1,451,106 |
| Balance after charges | 1,127,923 | 535,834 |

PHILADELPHIA RAPID TRANSIT.

| | 1913 | 1912 |
|---|---|---|
| November gross | $2,018,496 | $2,008,400 |
| Net | 844,516 | 812,141 |
| Surplus after charges | 52,265 | 50,303 |
| Five months gross | 10,098,015 | 9,860,293 |
| Net | 4,210,841 | 3,995,049 |
| Surplus after charges | 223,343 | 196,768 |

BRAZILIAN TRACTION, LIGHT & POWER.

| | 1913 | 1912 |
|---|---|---|
| November gross | $ 1,959,267 | $ 1,773,623 |
| Net after taxes | 1,103,108 | 1,006,231 |
| Ten months gross | 21,537,429 | 18,728,477 |
| Net after taxes | 11,675,186 | 10,193,146 |

PACIFIC LIGHT & POWER.

| | 1913 | 1912 |
|---|---|---|
| October gross | $ 258,518 | $ 230,108 |
| Net after taxes | 112,547 | 97,270 |
| Surplus after charges | 75,804 | 58,663 |
| 12 months gross | 2,843,223 | 2,480,400 |
| Net after tax | 1,266,260 | 1,076,161 |
| Surplus after charges | 795,222 | 581,154 |

UTAH POWER & LIGHT.

| | 1913 | 1912 |
|---|---|---|
| November gross | $ 162,653 | $ 120,388 |
| Net after taxes | 95,566 | 66,066 |
| Six months gross | 892,663 | 720,219 |
| Net after taxes | 536,873 | 377,075 |
| 12 months gross | 1,706,481 | 1,473,072 |
| Net after taxes | 1,006,515 | 802,597 |

MT. WHITNEY POWER & ELECTRIC.

| | 1913 | 1912 |
|---|---|---|
| November gross | $ 49,913 | $ 38,751 |
| Net after taxes | 31,113 | 21,839 |
| Surplus after charges | 20,838 | 13,964 |
| 12 months gross | 554,432 | 443,626 |
| Net after taxes | 304,158 | 229,673 |
| Surplus after charges | 180,858 | 135,173 |

MONONGAHELA VALLEY TRACTION.

| | 1913. | 1912. |
|---|---|---|
| November gross | $ 83,639 | $ 70,714 |
| Net after taxes | 51,344 | 44,719 |
| Surplus after charges | 25,562 | 19,951 |
| 11 months' gross | 872,470 | 776,164 |
| Net after taxes | 560,027 | 469,830 |
| Surplus after charges | 288,150 | 233,506 |

OTTUMWA RAILWAY & LIGHT.

The Ottumwa Railway & Light Company reports for the twelve months ended November 30 as follows:

| | 1913. | 1912. |
|---|---|---|
| Gross earnings | $319,286 | $297,993 |
| Net after taxes | 144,834 | 130,594 |
| Surplus after charges | 77,798 | 63,529 |
| Balance after preferred dividends | 46,305 | 32,036 |

MUSKOGEE GAS & ELECTRIC.

The Muskogee Gas & Electric Company reports for the twelve months ended November 30 as follows:

| | 1913. | 1912. |
|---|---|---|
| Gross earnings | $523,745 | $534,059 |
| Net after taxes | 224,003 | 214,248 |
| Surplus after charges | 152,965 | 141,592 |
| Balance after preferred dividends | 52,634 | 41,387 |

KINGS COUNTY ELECTRIC LIGHT & POWER.

| | 1913 | 1912 |
|---|---|---|
| November gross | $528,634 | $470,452 |
| Net after taxes and depreciation | 215,631 | 161,729 |
| Other income | 5,410 | 3,826 |
| Total income | 221,040 | 165,555 |
| Surplus after charges | 149,470 | 97,165 |
| Eleven months gross | 5,091,630 | 4,664,983 |
| Net after taxes and depreciation | 1,894,338 | 1,602,654 |
| Other income | 59,662 | 51,270 |
| Total income | 1,954,000 | 1,653,924 |
| Surplus after charges | 1,150,243 | 836,217 |

SOUTHWESTERN POWER & LIGHT.
(Subsidiary Companies.)

| | 1913 | 1912 |
|---|---|---|
| November gross | $ 232,802 | $190,400 |
| Net after taxes | 102,251 | 87,293 |
| Six months gross | 1,177,230 | 1,009,355 |
| Net after taxes | 541,547 | 438,169 |
| Twelve months' gross | 2,257,568 | 1,923,080 |
| Net after taxes | 1,020,146 | 851,718 |

MASSACHUSETTS LIGHTING COMPANIES.

The several gas and electric properties of the Massachusetts Lighting Companies report as follows:

| | 1913 | 1912 |
|---|---|---|
| November net sales | $ 97,514 | $ 95,167 |
| Five months' net sales | 442,104 | 419,291 |

DETROIT EDISON.

| | 1913 | 1912 |
|---|---|---|
| November gross | $ 529,288 | $438,099 |
| Net after taxes | 242,256 | 199,216 |
| Surplus after charges | 181,332 | 138,226 |
| Depreciation | 55,200 | 46,000 |
| Balance | 126,132 | 92,226 |
| 11 months' gross | 4,963,413 | 3,906,315 |
| Net after taxes | 2,049,264 | 1,628,077 |
| Surplus after charges | 1,416,993 | 978,026 |
| Depreciation | 476,726 | 411,240 |
| Balance | 940,267 | 566,786 |

VIRGINIA RAILWAY AND POWER.

| | 1913 | 1912 |
|---|---|---|
| November gross | $ 429,332 | $406,832 |
| Net | 214,920 | 212,712 |
| Surplus after charges | 88,031 | 97,898 |
| Five months' gross | 2,168,630 | 2,026,193 |
| Net | 1,072,132 | 1,014,538 |
| Surplus after charges | 444,990 | 433,738 |

TEXAS POWER & LIGHT.

| | 1913 | 1912 |
|---|---|---|
| November gross | $ 134,081 | $100,092 |
| Net after taxes | 47,236 | 43,249 |
| Surplus after charges | 23,601 | 31,210 |
| 12 months' gross | 1,162,745 | 984,636 |
| Net after taxes | 436,019 | 407,513 |
| Surplus after charges | 239,815 | 300,803 |
| Balance after preferred dividends | 129,565 | 256,440 |

KANSAS POWER & LIGHT.

| | 1913 | 1912 |
|---|---|---|
| November gross | $ 102,735 | $ 80,196 |
| Net after taxes | 41,310 | 32,698 |
| Balance after charges | 26,213 | 20,163 |
| Twelve months' gross | 1,018,755 | 998,855 |
| Net after taxes | 361,311 | 348,157 |
| Balance after charges | 185,752 | 195,164 |
| Balance after preferred dividends | 80,752 | 90,164 |

FORT WORTH POWER & LIGHT.

| | 1913 | 1912 |
|---|---|---|
| November gross | $ 66,798 | $ 49,458 |
| Net after taxes | 36,373 | 25,283 |
| Surplus after charges | 29,460 | 19,692 |
| 12 months' gross | 648,970 | 504,050 |
| Net after taxes | 378,715 | 246,123 |
| Surplus after charges | 298,088 | 185,727 |
| Balance after preferred dividends | 246,180 | 142,327 |

ST. JOSEPH RAILWAY, LIGHT, HEAT & POWER.

| | 1913 | 1912 |
|---|---|---|
| November gross | $ 110,092 | $100,787 |
| Net after taxes | 50,214 | 46,292 |
| Surplus after charges | 29,983 | 26,582 |
| 12 months' gross | 1,245,949 | 1,170,366 |
| Net after taxes | 536,698 | 502,750 |
| Surplus after charges | 295,817 | 266,692 |
| *Balance after preferred dividends | 217,817 | 188,692 |

*Equivalent to 6.2 per cent on common stock.

CLOSING BID PRICES FOR ELECTRICAL SECURITIES ON THE LEADING EXCHANGES AS COMPARED WITH THE PREVIOUS WEEK.

| | Jan. 5 | Dec. 29 |
|---|---|---|
| American Tel. & Tel. (New York) | 118½ | 123 |
| Commonwealth Edison (Chicago) | 133 | 127 |
| Edison Electric Illuminating (Boston) | 245 | 241 |
| Electric Storage Battery common (Philadelphia) | 47 | 46¾ |
| Electric Storage Battery preferred (Philadelphia) | 47 | 46¾ |
| General Electric (New York) | 140⅜ | 140 |
| Kings County Electric (New York) | 119 | 119 |
| Manhattan Transit (New York) | 1⅛ | 1¼ |
| Massachusetts Electric common (Boston) | 12 | 13 |
| Massachusetts Electric preferred (Boston) | 63½ | 63½ |
| National Carbon common (Chicago) | 132 | 132 |
| National Carbon preferred (Chicago) | 115 | 113 |
| New England Telephone (Boston) | 133 | 132 |
| Philadelphia Electric (Philadelphia) | 26 | 25⅞ |
| Postal Telegraph and Cables common (New York) | 75 | 76 |
| Postal Telegraph and Cables preferred (New York) | 65 | 65 |
| Western Union (New York) | 59¾ | 57¾ |
| Westinghouse common (New York) | 64½ | 66 |
| Westinghouse preferred (New York) | 114½ | 112 |

*Last price quoted.

## PERSONAL MENTION.

MR. THOMAS HOWE has severed his connection with Edwards, Sager & Wooster, and will continue his practice in relation to patents, copyrights and trade marks at 2 Rector Street, New York City.

MR. HENRY HEICK has resigned as vice-president of Albrecht & Heick, a leading electrical contracting house and dealer of Louisville, Ky., after having been connected with the company for 27 years. The concern will be operated by Gustave Albrecht, Sr., president; Gustave, Jr., secretary, and Clarence Albrecht. Mr. Heick will probably enter the hardware business.

MR. W. A. ALLEN, formerly with the Carnegie Steel Company, has been employed as commercial engineer for the R. D. Nuttall Company, Pittsburgh, Pa. Mr. Allen's experience in the manufacture, selection and treatment of materials, well fits him for this important position. Mr. Allen's duties are such that he will eventually come in touch with practically every electric railway company in the country.

MR. EDWARD W. STEVENSON, for many years chief engineer of the Hazard Manufacturing Company, Wilkes Barre, Pa., was tendered a testimonial banquet on Tuesday evening, December 30, at the Hotel Redington, Wilkes Barre, upon the occasion of his resignation from the company Mr. Stevenson will act as sales agent for Smith & Nichols, dealers in waxes, saturations and other insulating material used in wires and cables for electrical purposes.

MR. H. A. HAMPTON resigned from the position of chief engineer of the Tampa Water Works Company, Tampa, Fla., on January 1, in order to devote his entire time to the engineering firm of Hampton & Buerke, whose work consists principally in installing and supervising the operation of power plants in Florida. Mr. Hampton was for 12 years in charge of the power department of the Tampa Electric Company, and during the last five years has been chief engineer of the Tampa Water Works Company.

MR. JOHN F. WESSELL, general manager of the Mahoning & Shenango Railway & Light Company, a subsidiary of the Republic Railway & Light Company, will return to New York to assume duties with that corporation. The office of general manager has been abolished. MR. RANDALL MONTGOMERY, assistant to the president, has been appointed vice-president; G. J. A. PAUL, general superintendent, has been made manager of railways and MR. HOWARD V. MANINGTON, of Columbus, has been appointed assistant to the president.

DR. LEE de FOREST, the inventor of many wireless telephone and telegraph devices, who was tried in the United States courts at New York along with officials of the Radio Wireless Company, on the alleged misuse of the United States mail, was acquitted on three counts, the jury disagreeing on the fourth. In this case the jury returned a verdict of guilty on two counts of the indictment against MR. JAMES DUNLOP, president and MR. ELMER E. BURLINGAME, agent of a subsidiary company. MR. S. DARBY was also acquitted.

MR. GEORGE B. JOHNSON, manager of the Commonwealth Edison Company's Electric Shop, Chicago, was awarded the first prize ($25) for the best suggestion for a slogan in the *Chicago Tribune's* campaign to develop courtesy toward women, especially in the way of providing them with seats on railways and public conveyances. Mr. Johnson's suggestion was "Seats for Women." Since Mr. Johnson has been regarded as a confirmed bachelor by his many friends the award of this prize comes as a pleasant surprise in showing his keen regard for the ladies.

MR. SLAUGHTER F. HUFF, president of the Coney Island & Brooklyn Railway Company, has been elected vice-president of the Brooklyn Rapid Transit Company, to succeed MR. GEORGE F. CALDERWOOD, whose resignation was announced last week. Mr. Huff's present duties as head of the Coney Island & Brooklyn system will automatically cease in a short time, owing to a recent merger of that system with the Brooklyn Rapid Transit Company. It is understood that Mr. Huff will not perform the functions of general manager, as this position was abolished with Mr. Calderwood's resignation.

MR. JAMES CLARK, Jr., president of the James Clark Jr., Electric Company, of Louisville, leading manufacturers of electrical equipment, had what is regarded as a miraculous escape from death recently, when he missed being crushed to death in an elevator accident only by inches. Mr. Clark was attempting to bring the service elevator used in the company's Main street store to the first floor. It came from below, instead of above, as he thought, and struck him under the chin, carrying him up, while the safety gate descended from above, catching him between the edge of the car and the gate. It happened that one of the palings on the gate was loose, and this gave under the pressure of Mr. Clark's body, permitting him to slip through. He fell through the shaft into the basement of the building, receiving a dislocated wrist, numerous cuts and bruises and a general jarring up. Though he has been in bed as a result of the accident, his recovery is assured.

## OBITUARY.

MR. CHARLES W. CORNELL, secretary and treasurer of the Gamewell Fire Alarm Telegraph Company, died suddenly at his home in Brooklyn, N. Y., on January 1. He was 69 years of age.

MR. SAMUEL A. COLEMAN, a well known old-time telegrapher, died at his home in Brookyln, N. Y., at noon, Monday, December 29. Mr. Coleman had several official positions with the Postal Telegraph Company and was employed there at the time of his death.

MR. CHARLES E. WAYS, assistant general traffic manager of the Baltimore & Ohio Railroad, died at Baltimore, on January 2. He was 70 years of age. Mr. Ways was employed as a telegrapher at Harper's Ferry, W. Va., at the time of the John Brown raid in 1859, and, it is said, sent the telegram that announced Brown's attack on the United States Arsenal there.

MR. FRANCIS R. FROST, electrical engineer of the Atchison, Topeka & Sante Fe Railway, died at Las Vegas, N. M., on December 29. Mr. Frost went to New Mexico only recently in the hope that his health would be improved by the change of climate. This expectation was not borne out and the engineer sank steadily. Mr. Frost was conspicuous in electric car-lighting circles of the United States, devoting his time almost exclusively to this feature. Practically all of the passenger coaches of the Sante Fe system were equipped with electric lamps under his supervision. Mr. Frost was attacked by tuberculosis about eight months ago. He had headquarters at Topeka, Kans., and interment was in that city.

## NEW PUBLICATIONS.

CANADIAN COAL PRODUCTION.—The Canadian Department of Mines has published bulletin No. 258 dealing with the production of coal and coke in Canada in 1912, by John McLeish.

SWISS POWER HOUSES.—The Schweizerischer Elektrotechnischer Verein, Zurich, Switzerland, has issued a volume giving statistics of the electric power houses in Switzerland for the year 1911. It is published in both German and French and is a supplement to the *Bulletin* of the Society.

NEW YORK CITY SUPPLIES.—A report by E. C. Church, chief of the Bureau of Supplies of New York City, dealing with supplies of the Department of Water, Gas and Electricity, has been published. Its different chapters are concerned with the following subjects: plan and scope, organization and administration, purchasing, inspection, storage and issue, records and accounts. The report is well illustrated and nicely gotten up.

PHILADELPHIA TRANSIT REPORT.—The report of the Transit Commissioner, A. Merritt Taylor, to the Mayor and City Councils of Philadelphia has been published in two volumes. It consists of a comprehensive study of Rapid Transit needs in that city and contains recommendations for the construction of definite subway and elevated lines. It is recommended that the subway be financed by the city, but be operated by the present street railway company. The technical work, upon which the report is based, was conducted under the supervision of Ford, Bacon & Davis, consulting engineers.

## DATES AHEAD.

National Independent Telephone Association. Annual convention, Chicago, Ill., January 13-15.

South Dakota Independent Telephone Association. Sioux Falls, S. D., January 14-15.

Wisconsin Electrical Association. Annual convention, Milwaukee, Wis., January 15-16.

Electrical Contractors' Association of the State of Illinois. Annual meeting. Springfield, Ill., January 16-17.

Efficiency Society. Annual convention. New York, N. Y., January 26-27.

Western Association of Electrical Inspectors. Annual meeting, Cincinnati, O., January 27-30.

Northwestern Cedarmen's Association. Annual convention, Escanaba, Mich., January 27-28

American Electric Railway Association. Mid-year meeting, Engineering Societies Building, New York, N. Y., January 29-31.

American Institute of Mining Engineers. Annual convention, New York, N. Y., February 17-20.

American Institute of Electrical Engi-

neers. Annual mid-winter convention, Engineering Societies Building, New York, N. Y., February 25-27.

State Independent Telephone Association. Des Moines, Iowa. March 10-12.

Telegraphers' Mutual Benefit Association. New York, N. Y., March 11.

American Railway Engineering Association. Annual convention. Chicago, Ill., March 17-20.

American Electrochemical Society. New York, N. Y., April 16-18.

# With the Electrical Manufacturers

**Three States Cedar Company,** Minneapolis, Minn., producer of cedar poles, is sending out one of the most handsome calendars of the year.

**Greenwich Sales Company,** New York City, has opened offices at 257 Broadway and will represent manufacturers of electrical specialties in New York City and vicinity.

**Wagner Electric Manufacturing Company,** St. Louis, Mo., announces the removal of its Boston office to 77 Franklin Street. This office will continue in charge of Mr. Brooks Faxon.

**Belden Manufacturing Company,** Twenty-third Street and Western Avenue, Chicago, Ill., has issued its discount and price list No. 127. This applies to Belden catalog No. 5 and includes some special revised discounts on Beldenite rubber-covered Code wire.

**R. D. Nuttall Company,** Pittsburgh, Pa., informs us that a prominent road operating in the hills of western Pennsylvania has in service a gear that has made 583,000 miles. This is an untreated normal cast-steel Nuttall gear. It is believed to be good for at least 100,000 miles more. In addition to this phenomenal record, this same road has 50 other gears in the same service that have equally good records.

**Simplex Wire & Cable Company,** Boston, Mass., has on the press a 92-page manual which just fits the pocket as well as the need of every electrical man who has anything to do with wiring problems. It is full of tables and other information of all sorts about insulated conductors and other matters electrical, and is equipped with an unusually complete index. Printed on a fine thin paper, and bound with stiff covers, the book is to be distributed gratis to those who ask for it.

**Geoge C. Richards Company,** 629 West Jackson Boulevard, Chicago, has taken over the house electrical goods and alarm systems manufactured by Edwards & Company, New York, for a large central western territory. This energetic manufacturing agency is growing rapidly and represents a number of leading manufacturers of electrical material. Mr. Charles J. French has resigned from the contract department of the Commonwealth Edison Company to handle the Edwads line in Chicago and vicinity for Mr. Richards.

**Hamilton-Beach Manufacturing Company,** Racine, Wis., the well known manufacturer of fan motors, vibrators, and other current-consuming devices, has met with most gratifying results in the extension of its business during the past year. Mr. F. J. Ossius, president of the company, reports that the company's business in 1913 was far in excess of that of any previous year. Hamilton-Beach products are used all over the United States and seem to be meeting with popular favor. The contractors and dealers who are pushing H-B goods are increasing their list of customers thereby.

**Dubilier Electric Company, Incorporated,** 63 Fifth Avenue, New York City, has added several new bulletins to its electric catalog. Of these, one describes electric radiators of 550 and 1,100-watt size; these radiators embody the Dubilier resistance-wire units which are said to be more serviceable than lamps for this purpose. Several other bulletins are devoted to illustrated descriptions of some of the resistance units. The design of these units and their mounting is described for various kinds of service. Among the types referred to are units for heating apparatus, controllers, plain rheostats and motor starters, also resistance bands and cord resistances.

**American District Steam Company,** North Tonawanda, N. Y., is sending out to patrons and friends a beautiful, large calendar for 1914. Its outside dimensions are 21.5 by 46 inches. On it is reproduced the famous painting by DeLand depicting with historical fidelity and great beauty of color the first inauguration of George Washington as President of the United States, which took place on the portico of Federal Hall in New York City, April 30, 1789. The reproduction is 16 by 20 inches in size, surrounded by an attractive border bearing the legend of the American District Steam Company, which has been in the business of engineering, manufacturing and installing central steam heating equipment continually since 1877.

**The Leeds & Northrup Company,** 4901 Stenton Avenue, Philadelphia, Pa., has issued bulletin No. 476 describing its unit type Wheatstone bridges and resistance boxes. These are of the dial decade type arranged for very convenient control. In the bridge sets one dial is used for controlling both of the bridge ratio arms; thus when making a resistance measurement the rheostat value is multiplied by the setting of the ratio dial. These ratio multipliers are 0.001 to 1,000, each varying by the factor 10. The coils are wound on metal spools and the entire equipment is made to afford maximum protection and serviceability for sets of this kind.

**Westinghouse Electric & Manufacturing Company,** East Pittsburgh, Pa., has added a number of new pamphlets to its publications. "Westinghouse Portable Meters" is the title of circular No. 1104, a rather elaborate publication describing the company's complete line of portable instruments. A number of detail and complete photographs are shown together with various diagrams. "Motor-Driven Refrigerating and Ice-Making Machinery" (section No. 3133) describes the process employed in this class of work and illustrates the application of motors thereto. A number of interesting installations are shown and a curve is given from which the horsepower required for machines of different tons capacity can be determined. There is also included a table showing the type, capacity and speed of motors required for the different machines in a refrigerating plant, together with the kilowatt-hours consumption. "Baldwin-Westinghouse Electric Mine Locomotives" is the title of a pamphlet which describes and illustrates very fully the construction of the modern electric locomotive. A large number of views are given, showing construction details, particularly of the new bar-steel frame locomotive whose advantages are pointed out. The various accessories, such as controllers, circuit-breakers, trolley and gathering reels, are also described.

# Record of Electrical Patents.

## Issued by the United States Patent Office, December 30, 1913.

**1,082,484. Lamp Socket.** W. F. Anklam, assignor, to C. M. Hall Lamp Co., Detroit, Mich. For use with automobile reflector headlights.

**1,082,494. Coil Forming Apparatus.** J. A. Burns, assignor to Westinghouse Electric & Mfg. Co. A coil-forming mold has a laterally movable block adjacent to a shoulder, and worm and screw mechanicism for moving the block.

**1,082,511. Alternating-Current Motor.** C. Le G. Fortescue, assignor to Westinghouse Electric & Mfg. Co. A single-phase railway motor with armature and field in parallel circuits, the relative current in which is controlled by a regulating transformer.

**1,082,529. Apparatus for Forming Oxides of Nitrogen.** J. S. Island, Toronto, Ont. Includes a hollow electrode of circular form and having openings adapted to project an annular sheet of gas, and an electrode in the plane of the projected gas and adapted to form a ring of electric flame.

**1,082,532. Dynamo-Electric Machine.** B. G. Lamme, assignor to Westinghouse Electric & Mfg. Co. A damper for synchronous machines, has polar projections on the field that comprise groups of independent closed-circuit interpolar coils.

**1,082,561. System of Distribution.** E. H. Schwarz, assignor to Westinghouse Electric & Mfg. Co. A lighting system with a three-phase constant-current and regulator having independently movable coils for its respective phases, and a three-phase Y-connected and grounded-neutral lighting circuit with series lamps connected to the regulator. (See cut.)

**1,082,563. Coil for Electrical Apparatus.** H. B. Smith, assignor to Westinghouse Electric & Mfg. Co. Comprises a spiral of small cotton-covered wire, the successive turns of the covering being sewed to each other by zigzag stitches forming the spiral.

**1,082,566. Thermostatic Device for Varying Magnetic Field.** J. K. Stewart, assignor to Stewart-Warner Speedometer Corporation, Chicago, Ill. For a magnetic speedometer.

**1,082,571. Commutator Brush.** T. W. Varley, assignor to Westinghouse Electric & Mfg. Co. An adjustable strap brush for engaging the side of a commutator for a measuring instrument.

**1,082,577. Railway Signal-Lantern.** A. A. Ziegler, Boston, Mass. Has two incandescent lamps arranged on an electromagnetically slidable base plate so as to be moved into the focus of the lens.

**1,082,579. Dynamo-Electrical Machine.** D. H. Andrews, Newton, and E. C. Ketchum, Boston, Mass. The field has alined pole pieces with parallel faces, through the center of which the armature shaft passes.

**1,082,587. Metal-Filament Incandescent Lamp.** M. D. Greengard, New York, N. Y. The filament is arranged in two parallel longitudinal planes joined by a transverse plane.

**1,082,603. Alternating-Current Induction Motor.** B. McCollum, Washington, D. C. Between the bars of a squirrel-cage rotor and one of the alternate end rings is a nickel connection to limit the starting current.

**1,082,604. Shade-Holder.** H. J. Morey, assignor to Pass & Seymour, Solvay, N. Y. Includes a contractible spring.

**1,082,606. Supervisor Alarm System.** J. G. Nolen, assignor to Fire Protection Development Co., New York, N. Y. Has duplicate conductors for each side of the system.

**1,082,615. Electric Switching Device.** R. Wikander, assignor to Westinghouse Electric & Mfg. Co. Automatic control switches for gradually short-circuiting the secondary resistance of a polyphase induction motor.

**1,082,652. Lathe.** C. F. Roth, Pilot Grove, Mo. Has electromechanical means for moving the tool carriage in and out.

**1,082,653. Induction Wattmeter.** G. A. Scheeffer, assignor to Roller Smith Co., New York, N. Y. The upper end of the meter shaft has a magnetic bearing and coil adapted to prevent axial play.

**1,082,654. Electric Meter.** G. A. Scheeffer, assignor to Roller Smith Co. Has special means for lifting and locking the spindle from the lower bearing during transport.

**1,082,667. Automatic Resetting Alarm Cutout for Electric Burglar-Alarm Systems.** J. P. Williams and H. Huhn, New York, N. Y., assignors to Electric Bank Protection Co. The cutout means are operated by a motor.

**1,082,683. Automatic Cut Out and Compensating Socket.** G. T. Dunklin, South Bend, Ind. Has a resistance wound around the socket that is automatically introduced into the circuit when the lamp circuit is broken. (See cut.)

**1,082,694. Electric Switch. E. A.** Halbleib, assignor to North East Electric Co., Rochester, N. Y. Includes a number of vertically movable switch plugs inclosed in a casing.

**1,082,703. Supervisory Alarm System.** J. G. Nolen, assignor to Fire Protection Development Co., New York, N. Y. Includes a number of alarm-circuit-closers actuated on increase of pressure in an air tube.

**1,082,721. Liquid Resistance.** A. Aichele, Baden, Switzerland. Comprises a fixed upper box provided with electrodes and a vertically adjustable lower vessel containing the resistance liquid.

**1,082,731. Combination-Lock and Circuit Breaker.** G. J. Buckeye, Kansas City, Mo., assignor to Automatic Combination Lock & Circuit Breaker Co. Tumblers for the permutation lock co-operate to control the pivoted arm.

**1,082,753. Artificial Light Diffusing Apparatus.** N. Losey, Indianapolis, Ind. A foldable umbrella-like diffuser and reflector, through whose stem the circuit wires pass, is placed over an inverted lamp with a concentrating reflector.

**1,082,759. Panel Board Switch.** J. A. Obermiller and P. Eickenberg, Chicago, Ill. A push-button switch for connecting to the branch bars.

**1,082,767. Riveted Metal-Work.** A. F. Rietzel, assignor to Universal Electric Welding Co., New York, N. Y. A combination riveting and electric spot-welding process.

**1,082,772. Conductor-Post for Electrical Distribution.** C. Schuster, Bellevue, and C. N. Bergmann, Pittsburgh, Pa. A spacing frame for busbars.

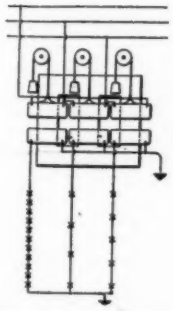
**1,082,799. Car Trolley.** F. E. Covey, Oakland, Cal., assignor of one-half to C. W. Yolland. A carrier for a telescopic trolley pole is arranged so it can turn on either side of a vertical axis.

**1,082,810. Electric Device.** A. A. Kent, Philadelphia, Pa. A contact device controlled by a double-notched rotary cam.

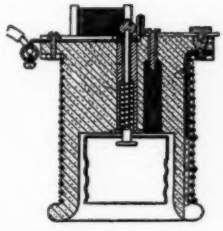
**1,082,811. Device for Uniting Insulated Conductors of Electricity.** A. A. Kent, Philadelphia, Pa. A plug type coupling.

**1,082,824. Railway-Cab Signal.** H. G. Sedgwick, Mill Valley, Cal., assignor to National Safety Appliance Co. A pair of contact arms for an electric signal is placed in a channel shoe on the locomotive.

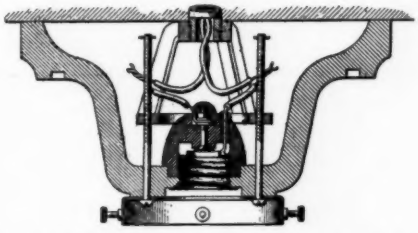
**1,082,830. Electric Heated Steering Wheel.** R. S. Smith, Marshall, Tex.



1,082,561.—Three-Phase Series Lighting System.



1,082,683.—Series Lamp Cutout and Compensator.



1,083,218.—Combined Shade and Hood-Holder.

**1,082,826. Insulating Means for Railway Ties and Chairs.** G. H. Shane, assignor to Steel Railway Tie & Appliance Co. A rail, chair and channel tie are all insulated from each other.

**1,082,825. Automatic Train-Stop.** H. G. Sedgwick, assignor to National Safety Appliance Co. The heating unit is secured to the closure for a recess in the wheel.

**1,082,840. Automatic System of Block Signaling for Electric Railways.** S. M. Young, New York, N. Y. An alternating-current system with impedances and track relays connected across the rails.

**1,082,856. Attachment for Controlling Telephone Switch-Hooks.** J. Frith, Bridgeport, Conn. For desk sets with special bracket to hold the receiver to the ear.

**1,082,869. Storage Battery.** A. S. Hubbard, assignor to Gould Storage Battery Co. A vent system for a sealed battery connected to each cell in the battery tray.

**1,082,887. Contact Device for Hand Lamps.** L. Maisel, Madison, Wis., assignor to Northern Chemical Engineering Laboratories. Operated by a sliding motion.

**1,082,920. Damper-Regulating Ap-** Electromagnetic control for the air brake.

**paratus.** H. B. Weir and J. L. Fyke, Milwaukee, Wis. Electromagnetically actuated.

**1,082,933. Tungsten and Method of Making the Same for Use as Filaments of Incandescent Electric Lamps and for Other Purposes.** W. D. Coolidge, assignor to General Electric Co. The process of producing ductile tungsten wire consists in forming a sintered body of the metal hot-swaging this repeatedly until it becomes fibrous in structure, and then reducing it by hot drawing.

**1,082,947 and 1,082,948. Process for Improving the Magnetic Qualities of a Magnetic Body.** R. A. Hadfield, Sheffield, Eng. Silicon steel is made by first heating the alloy to a temperature between 700 and 800 degrees C., cooling slowly, then reheating to a temperature between 900 and 1,000 degrees, and finally allowing the alloy to cool rapidly. The second patent interchanges the temperature limits of the two heatings.

**1,082,950. Arc-Light Electrode.** J. L. R. Hayden, assignor to General Electric Co. Is formed of a metal tube with a cast filling of a homogenous mass containing two or more metallic compounds welded to the tube.

**1,082,951. Combined Conductor's Valve and Emergency Switch.** F. Hedley, Yonkers, and J. S. Doyle, Mount Vernon, N. Y. A lever operates the air-brake valve and simultaneously opens the power circuit.

**1,082,956. Automatic Control System for Electric Railways.** B. F. Hutchens, Jr., Allendale, N. J. For a sectionalized single-track railway.

**1,082,962. System of Distribution.** H. A. Laycock, assignor to General Electric Co. A balancer set for a three-wire system has a resistance in the field circuit of each machine and a relay-controlled shunt for each resistance.

**1,082,967. Weighing and Recording Mechanism.** G. Moore, Weston County, Wyo. Includes an electrical recording system.

**1,082,978. Arc-Lamp Electrode.** C. P. Steinmetz, assignor to General Electric Co. A white-arc electrode composed of carbon associated with titanium carbide or equivalent.

**1,082,982. Rheostat.** R. L. Watkins, New York, N. Y. A folding rheostat consists of a number of resistance leaves, each provided with a collar and lug adapted to be alined for connection by a pin when the leaves are spread apart.

**1,083,017. Trolley.** P. Johnson, Heaton, N. Mex. Parallel guard plates are pivoted on each side of the wheel.

**1,083,020. Lighting Attachment for Sewing and Other Machines.** J. W. Love and C. Webster, Warren, O. A bendable conduit with reflector socket and lamp to concentrate light on the work.

**1,083,047. Trolley.** M. Adamski Stoneboro, Pa. Spring-pressed bow trolley.

**1,083,049. Convertible Trolley.** A. L. Behner and J. Scott, Cleveland, O. Has two wheels in tandem, the front one of standard construction and acting as a pilot and the rear one of barrel shape.

**1,083,070. Compound Metal.** B. E. Eldred, New York, N. Y. For leading in wires sealed into glass; consists of a nickel-steel core, a layer of copper and an outer sheath of platinum.

**1,083,073. Revolver Attachment.** M. Ferguson and J. O. Fitzgerald, Jr., Richmond, Va. Includes an electric flashlight.

**1,083,085. Loose-Coupled Tuning-Coil.** A. C. Gowing and M. C. Spencer, Worcester, Mass. Consists of a number of concentric rings carrying primary and secondary windings, one of the rings being fixed to a diametrical rod passing through all the rings, and the remaining rings being adjustable.

**1,083,109. Magnetic Wedge for Dynamo-Electric Machines.** B. F. Lee, Schoolfield, Va. A laminated-iron wedge in each slot to hold the coil in place.

**1,083,132. Electrode for Preventing Cathodic Reduction.** A. Pietzsch and G. Adolph, Munich, Germany. The cathode is closely wound around with an asbestos string.

**1,083,175. Commutator Slotter.** F. R. Alley, Seattle, Wash. Includes two guideways, a screw and a cutter.

**1,083,181. Insulating Rail-Fastener.** A. J. Bates, Chicago, Ill. An electrically insulated seat for the rail and a heavily enameled anchor for holding the rail to the seat.

**1,083,187. Electric Arc Lamp.** F. Buchanan, Dayton, O. A feeding clutch controlled by an electromagnetic pawl and ratchet.

**1,083,191. Thermo Electric Generator.** J. J. Cook, Jersey City, N. J. A thermopile with the terminal portions of the elements provided with passages for a temperature-controlling fluid.

**1,083,200. Electric Well-Drill.** H. E. Diehl, Lawton, Okla. Includes a solenoid - reciprocated bit - carrying plunger.

**1,083,210. Arc Lamp.** C. A. B. Halvorson, Jr., assignor to General Electric Co. A special cutout for a magnetite lamp is closed when the arcing face of the copper electrode is advanced before the normal position of the arcing face of the magnetic electrode.

**1,083,218. Adjustable Combined Shade and Hood-Holder.** C. G. Rush, Chicago, Ill. A pottery canopy or hood and a shade-holder are secured to a supporting ring attached to the fixture stud. (See cut, page 113.)

**1,083,221. Starter for Internal-Combustion Engines.** F. R. Simms, assignor to Simms Magneto Co., New York, N. Y. A special ignition system includes a magneto with induction coil and an auxiliary source which is connected to the induction coil through a trembler coil.

**1,083,222. Electric Ignition Apparatus.** F. R. Simms, assignor to Simms Magneto Co. A modification of the foregoing.

**1,083,255. Electric Transmission of Intelligence.** I. Kitsee, assignor to American Telephone & Telegraph Co., New York, N. Y. A telegraph transmission line is provided with means to impress on the line a potential independent of the potentials or impulses impressed during the transmission of the messages through a double condenser.

**1,083,256. Telephony.** I. Kitsee, assignor to American Telephone & Telegraph Co. Party line stations are provided with single-stroke bells connected in series to the line and operated by telegraphic keys in the line.

**1,083,257. Telegraph System.** I. Kitsee, assignor to American Telephone & Telegraph Co. A duplex system having a main line and an artificial line connected by the primary of a transformer, with a signal instrument controlled by the transformer secondary.

**1,083,258. Electric Transmission of Intelligence.** I. Kitsee, assignor to American Telephone & Telegraph Co. A cable has a series of lines each comprising three conductors, two composed of insulated wires and the third in the form of a metallic braiding surrounding the two wires, and a lead sheath outside the cable.

**1,083,259. Cable Telegraphy.** I. Kitsee, assignor to American Telephone & Telegraph Co. The method of operating sensitive relays connected in the line consists in causing two movements in the relay for each letter through line impulses, and causing the time unit of each movement to be lengthened through localized impulses.

**1,083,260. Electric Motor.** R. E. Noble, assignor to Morgan-Gardner Electric Co., Chicago, Ill. A vertical motor with a barrel-wound armature and a commutator with interior bearing surface extending within the end turns of the armature.

**1,083,266. Trolley Pole.** A. R. Christian, Christchurch, New Zealand. A special spring construction at the base to keep the hole elevated.

### Patents Expired.

The following United States electrical patents expired January 5, 1914:

574,370. Manufacture of Incandescent Electric Lamps. T. B. Atterbury, Pittsburgh, Pa.

574,377. Electric Railway Trolley. E. M. Bentley, New York, N. Y.

574,388. Electric Propulsion of Vehicles. W. A. Butler, New York, N. Y.

574,417. Secondary Battery and Process of Forming Same. G. W. Harris and R. J. Holland, New York, N. Y.

574,536. Electrically Heated Sadiron. W. S. Hadaway, Jr., New York, N. Y.

574,537. Automatically Controlled Electric Oven. W. S. Hadaway, Jr.

574,565. Electric Meter for Alternating Currents. G. F. Packard, Fort Wayne, Ind.

574,579. Circuit for Annunciators of Telephone Lines. C. E. Scribner, Chicago, and F. R. McBerty, Downer's Grove, Ill.

574,632. Electric Railway. W. M. Schlesinger, Philadelphia, Pa.

574,642. Telephone Switchboard. H. J. Swarts, Knoxville, Tenn.

574,654. Telephone Receiver. R. S. Barnum, Chicago, Ill.

574,669. Electric Clock. C. M. Crook, Chicago, Ill.

574,707. Automatic Telephone-Exchange System. I. C. Bowman, New York, N. Y.

574,739. Electric Measuring and Indicating Apparatus. J. F. Kelly, Pittsfield, Mass.

574,745. Electric Heater. J. R. Meek, New York, N. Y.

574,761. Agitator for Telephone Transmitters. S. B. Rawson, Elyria, O.

574,826. Secondary Battery Support or Gird. J. J. Rooney, Brooklyn, N. Y.

574,828. Insulator. B. D. B. Smock, Wickatunk, N. J.

574,843. Method of Electrolytically Uniting Glass Articles into a Body. W. H. Winslow, Chicago, Ill.

574,856. Electric Alarm Device. G. V. Trott, Chicago, Ill.